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Axioeventism as a Philosophical Concept of Everything

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Correction

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INTRODUCTION

The work entitled *Axioeventism as a Philosophical Concept of Everything* consists of ten chapters.

Chapter 1. I*ssue of Theoretical Assumptions* - outlines selected assumptions related to philosophy, scientific theories, and the three main assumptions of Axioeventism: 1) Total Reality (TR) consists of two dimensions: Ontic Universum (OU) and Reality of Abstract-Essential Structures (RAES); 2) Situationist Essentialism; 3) Systemic Approach.

Chapter 2. *Statics and Dynamics of Relatively Isolated Systems* - introduces the concept of Relatively Isolated System (RIS) and the global structure composed of essential and accidental structures. The dynamics of Relative Isolated Systems are determined by integrative and disintegrative proliferation.

Chapter 3. *Structural-Static Plane* - covers natural reality, psychic reality and social reality. The Reality of Abstract-Essential Structures (RAES) is also considered, including Mathematics Objects, Scientific Idealizations and Universals (positive and negative).

Chapter 4. *Indeterminacy and Determinacy in Axioeventism* - outlines three triads: the informational, eventistic and axiocreative triad, as well as the temporal triad. Within these triads, indeterminacy (uncertainty, chaos, disintegrative essentials proliferation and forecasting the future) and determinacy (certainty, order, integrative essential proliferation and reconstruction of the past) are specified.

Chapter 5. *Information and Informational Interactions* - discusses informational interactions and their effect, namely information. It emphasizes that informational interactions constitute a prerequisite for all other interactions.

Chapter 6. *Events and Eventistic Interactions* - all events occurring in any fragments of the Ontic Universum create Relative Isolated Systems (integrative proliferation) or contribute to their decay (disintegrative proliferation).

Chapter 7. *Values and Axiocreative Interactions* - The essence of values lies in being the outcome of axiocreative interactions, either on the line of integrative proliferation (positive values) or on the line of disintegrative proliferation (negative values).

Chapter 8. *Time and Temporal Interactions* - Time can be understood as total-time (eternalism) – a cohesive and simultaneous entity; objective – an infinite sequence of intervals between predecessors and successors of temporal interactions or as subjective time – the reconstruction by a conscious subject of past events or anticipation of future events.

Chapter 9. *Axioeventistic Concept of Man* - As an individual, a human possesses the following constitutive (positive) properties: life, rationality, dignity, and self-realization (perfection, happiness, pleasure). Society (people belonging to a collective) has the following constitutive (positive) properties: justice, freedom and security. Due to the characteristic of human rationality, the Axioeventistic Postulate is formulated, stating that humans should strive for the realization of positive values while avoiding negative values.

Chapter 10. *Axioeventistic Epistemology and Ontology* - Reality is objective, knowable, and independent of the knowing subject (axioepistemological realism). In the Ontic Universe (OU), the law of nature (lex naturalis) applies – the tendency of Relatively Isolated Systems (RIS) to either preserve their essential structure or undergo integrative or disintegrative proliferation. Meanwhile, natural law (ius naturale) is nothing more than a more or less adequate reflection of the law of nature (lex naturalis) in a conscious subject.

1. Issue of Theoretical Assumptions

1. Assumptions in the context of philosophy

At the core of both philosophical concepts and scientific theories, there are always certain assumptions (implicitly embedded or explicitly formulated) that lack a satisfying justification within the scope of these concepts or theories themselves. They may have a strictly *philosophical character* – grounded in reliable cognitive faculties (reason, senses, immanent intuition[1]) or a *metaphysical character* – based on unreliable cognitive faculties (such as revelation, mystical experiences, transcendent intuition). In both cases, one can distinguish *ontological* assumptions (pertaining to existence) – characterizing the broadly understood reality, *epistemological* assumptions (concerning knowledge) – specifying something about cognitive faculties and the limits of their applicability, and *methodological* assumptions – defining ways of knowing the broadly understood reality, i.e., accessible to any form of cognition.

In relation to philosophical concepts (applying the criterion of the essence of reality, truth, and the relationship of philosophy to science), we can adopt, for example, the following assumptions (Table.1.1.).

Ontological	**Epistemological**	**Methodological**	
Ancien Philosophy of Being	***Modern Philosophy of Consciousness***	***Contemporary Philosophy of Language***	***Sociocultural Constructivism***
Hard essentialism	Soft essentialism	Soft Anti-Essentialism	Hard Anti-Essentialism
Classical Theory of Truth	Correspondence Theory of Truth	Semantic Theory of Truth	Non-Classical Theories of Truth

[1] *Immanent intuition* is one that presupposes either instantaneous (in the Epicurean sense) or direct (in the Leibnizian sense) knowledge of any object. Its opposite is *transcendent intuition* - a set of ideas about the reality beyond sensory perception and beyond reason.

Complete Unity of Philosophy and Sciences	Partial Unity of Philosophy and Sciences	Fundamental Separation of Philosophy and Sciences	Anti-Philosophy

Table 1.1. Philosophical Assumptions in Philosophical Frameworks

Ancient Philosophy of Being

Hard Essentialism. In general, *essentialism* in philosophy and science is a perspective according to which beneath the surface of phenomena and objects lies their essence (nature). This essence is a set of properties and relations that necessarily and indispensably belong to the set of objects of a given kind (in terms of denotation, to use a semiotic term), determining its specificity and distinctiveness from others. The essentialist analysis pertains to all sets of properties and relations that constitute the essence (nature) of any objects of any kind, irrespective of the plane of reality broadly understood (e.g., nature or society). In other words, the subject of knowledge is exclusively the essence; only knowledge that reaches the essence is valuable and worthy of acquisition. *Hard essentialism* is used when such an analysis is directly applied to any objects. On the other hand, *soft essentialism* refers to a situation where the essentialist analysis is applied indirectly (i.e., through the prism of consciousness – modern philosophy of consciousness – or through the prism of language – contemporary philosophy of language) and conditionally.

In philosophy, the existence of three distinct archetypes of understanding reality can be observed: *monism*, *dualism*, and *pluralism*.

Monism. Pure monism was present in the philosophy of *Parmenides* (540-470 BC), who understood reality as a singular, coherent, unchanging (static, motionless), eternal, and real (true) entity. Monism was conceived differently by *Plotinus* (205-270 BC) and *G.W. Hegel* (1770-1831), specifically as an image of a differentiating reality process. In Plotinus, the beginning of this process is the One-Absolute - the unity of beauty, goodness, and truth, which necessarily emanates progressively less perfect hypostases, differing in their degree of deviation from the initial unity and causal dependencies (what is higher conditions what is lower). Conversely, in Hegel, the initiation of reality differentiation is the least perfect factor, namely, thought identical to being. This initial, uncompounded factor evolves, due to the operation of the dialectical principle of contradiction (the source of all changes) and the dialectical principle of negation of negation (the infinity of the negation sequence), through nature toward spirit (subjective, objective, and absolute). As evident, Parmenides' conception is static, while Plotinus and Hegel present dynamic perspectives.

Dualism is primarily represented by *Plato* (424-348 BC), who distinguishes two spheres of reality: the ideal world and the material world[2]. In this way, Plato reconciles two currents present in pre-Platonic philosophy: the static monism of Parmenides (unchanging, eternal, and real being) and the Heraclitean variability (changing, temporal, and apparent being):

Parmenides - unchanging being (static, motionless), eternal, and real (true).	*Heraclitus* - changing being, temporal, and apparent (illusory).
Ideal world - a collection of ideas (supreme and generic) that exist inherently (per se).	*Material world* - a collection of things that exist as shadows due to participation in ideas.

The main characteristic of Plato's dualism is precisely the emphasis on two distinct but structurally homogeneous entities: on one hand, the world of ideas, and on the other, the material world. The extended, perceptible world, if not illusory, is certainly something secondary in relation to the true, non-extended, and sensorially imperceptible world of ideas. Essential to Platonism is the acceptance of the ideal realm as ontologically primary, autonomous, and the treatment of the real realm as ontologically secondary.

Among the philosophical dualists of ancient times, we must also include *Aristotle* (384-322 BC). Plato maintained that the real (true) being is the world of ideas. According to Aristotle, however, real being cannot exist outside the sensory experiential world. Real being resides solely in what is concrete and individual (being singular). Nevertheless, there must always, necessarily, exist in individual being what is abstract, general, and unchanging. The concrete element is *matter* (equivalent to Plato's material world), and the abstract element is *form* (equivalent to Plato's world of ideas).

Pluralism involves accepting the existence of many (more than two) kinds of being with fundamental uniqueness and distinctiveness between them. In ancient times, the first consistent philosophical

[2] On the other hand, René Descartes (1596-1650) speaks of the order of the mind and the order of matter; Immanuel Kant (1724-1804), following this line of thought, emphasizes the distinction between the senses and reason, that which is a posteriori and that which is a priori.

pluralist was *Empedocles of Agrigentum* (495-435 BC). He divides Parmenides' One into four elements, called roots (*rhizai*) or elements (*stoicheia*): water, air, earth, and fire. The elements are set in motion, i.e., they combine and separate through two distinct forces with a material character: love (*philia)* - unites everything diverse and separates homogeneous objects; strife (*neikos*) - unites everything homogeneous and separates diverse objects. The clash between love and strife results in a state of perpetual creation (*kosmein*) of structures arranged in a certain way. *Anthony J.P. Kenny* (1931-) sees an analogy between Empedocles' elements and forces and the states of matter and attractive and repulsive forces discussed in contemporary physics.

> We are accustomed to think of solid, liquid, and gas as three fundamental states of matter. It was not unreasonable to think of fire, and in particular the fire of the sun, as being a fourth state of matter of equal importance. Indeed, in our own century, the emergence of the discipline of plasma physics, which studies the properties of matter at the temperature of the sun, may be said to have restored the fourth element to parity with the other three. Love and Strife can be recognized as the ancient analogues of the forces of attraction and repulsion which have played a significant part in the development of physical theory through the ages[3].

Ontological philosophizing (philosophy of being) is - as seen in the example of ancient monists, dualists, and pluralists - always a form of philosophizing focused on the analysis of external objects, not on one's own mental contents. It thus extends beyond the sphere of immanence. This is precisely what ancient *hard essentialism* entails.

Classical theory of truth. It originates from *Aristotle* and is most commonly known in either an ontic formulation (*verum est id, quod est*) or an epistemic formulation (*verum est adequatio rei et intellectus*) associated with *Thomas Aquinas* (1225-1274). Aristotle himself essentially said nothing about *agreement*, *adequacy*, or *identity*, although he undoubtedly implicitly assumed some correlation between speaking and the reality being spoken about:

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[3] Anthony Kenny (2006), *An Illustrated Brief History of Western Philosophy*, Blackwell Publishing Ltd, pp. 15-16.

> To say of what is that it is not, or of what is not that it is, is false, while to say of what is that it is, and of what is not that it is not, is true. (…) But since that which is in the sense of being true or is not in the sense of being false, depends on combination and separation, and truth and falsity together depend on the allocation of a pair of contradictory judgements; for the true judgement affirms where the subject and predicate really are combined, and denies where they are separated, while the false judgement has the opposite of this allocation. (…) It is not because we think truly that you are pale, but because you are pale we who say this have the truth[4].

In Anglo-American literature, there often emerged an opposition between two understandings of the concept of classical truth[5]. The *first* concerns truth as a property of something, to which this property may, but does not have to belong (e.g., the property of being pale in a person). The relation (more precisely: correspondence or adequacy) between this property and its bearer is not necessary (a person does not necessarily have to be pale). Moreover, correspondence between properties of an object and a subject not indicating them is also not necessary; it is entirely irrelevant. The *second* understanding of classical truth consistently situates it on epistemic-linguistic grounds as a correspondence between a statement (written or spoken) and reality. This version of the classical conception is specifically referred to as the correspondence theory of truth.

One could then distinguish two types of classical truth: Aristotelian - *ontic*, and Thomas Aquinas - *correspondence*.

Ontic truth – the truth is what is (*verum est id, quod est*). Truth and falsehood revolve around whether an object possesses certain properties or not. The way these properties connect with objects is reflected in judgment by the subject combining with the predicate: '*the true judgment affirms where the subject and predicate really are combined, and denies where they are separated, while the false judgment has the opposite of this allocation'*. Aristotle distinguishes predicates of three kinds: 1. indicating accidental properties – not reflecting the essence of a human (e.g., a person has the ability to acquire food); 2. indicating quasi-attributive properties – characterizing secondary generic properties of the object (e.g., a

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[4] William D. Ross (1924), *Aristotle's Metaphysics*, Clarendon Press, Oxford, 1011 b, 1027 b, 1051 b.

[5] See: J.P. Thompson, *Truth – Bearers and the Trouble about Propositions* [in:] The Journal of Philosophy, LXVI, no. 21, p. 737.

person has the ability to speak); and 3. indicating attributive properties – characterizing essential generic properties (e.g., a person is a rational being); this is precisely the essence (essence) of a human in Aristotle's philosophy.

Let's notice that Aristotle consistently remains within the ontological dimension; the foundation of truth is an independent being. In other words, truth has an ontic grounding; truth is a being in the sense that a given object possesses specific properties. Man can only speak about what exists or what does not exist, but this act of speaking does not fulfil any function in itself; the subjective factor is entirely secondary, albeit not insignificant. The statement of the subject does not necessarily have to correspond to anything; it simply boils down to a straightforward observation.

Correspondence truth- 'Truth is the equation of thing and intellect' (*verum est adequatio rei et intellectus*), which is equivalent to: 'A judgment is said to be true when it conforms to external reality'. The classical definition of truth in its epistemic version, more commonly known as the correspondence theory (popularized by Thomas Aquinas), was formulated by *Isaac Israeli ben Salomon* (832-932), a Jewish physician and philosopher living in Egypt. His book, translated into Latin by *Gerard of Cremona* (1114-1187) as *De elementis and De definitionibus* introduced this classical understanding of truth in its epistemic form. The epistemic version, now more commonly referred to as the correspondence theory of truth, can be interpreted in various ways.

Thus, for example, *Bertrand Russell* (1872-1970) associates truth with beliefs:

> (2) It seems fairly evident that if there were no beliefs there could be no falsehood, and no truth either, in the sense in which truth is correlative to falsehood. If we imagine a world of mere matter, there would be no room for falsehood in such a world, and although it would contain what may be called 'facts', it would not contain any truths, in the sense in which truths are thins of the same kind as falsehoods. In fact, truth and falsehood are properties of beliefs and statements: hence a world of mere matter, since it would contain no beliefs or statements, would also contain no truth or falsehood[6].

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[6] Bertrand Russell, *The Problems of Philosophy*, Chapter XII. *Truth and Falsehood* [in:] https://www.gutenberg.org/cache/epub/5827/pg5827-images.html#link2HCH0012.

Similarly, *George E. Moore* (1873-1958) expresses a similar view:

> To say of this belief that it is true would be to say of it that the fact to which it refers is-that there is such a fact in the Universe as the fact to which it refers; while to say of it that it is false is to say of it that the fact to which it refers simply is not-that there is no such fact in the Universe. (…) We might say quite generally: To say that a belief is true is to say always that the tact to which it refers is or has being, while to say of a belief that it is false is to say always, that the fact to which it refers, is not or has no being[7].

At the same time, it should be noted that even in antiquity, there were critical voices against the prevailing understanding of truth. Thus, according to *Sextus Empiricus*, the very existence of truth is problematic, and therefore any criteria of truth, even if they exist, are meaningless because they are as problematic as truth itself. In *Pyrrhoniae Hypotyposes* we read:

> [74] Nor can we say that the soul apprehends external existing objects through its sensory feelings inasmuch as the feelings of the senses are similar to the external existing objects. For how will the intellect know whether the feelings of the senses are like the sense-objects, given that it does not itself come into contact with the external objects and that the senses make clear to it not the nature of these objects but their own feelings, as we deduced from the modes of suspension? [75] Just as someone who does not know Socrates but has looked at a picture of him does not know whether the picture is like Socrates, so the intellect, studying the feelings of the senses but not observing the external objects, will not know whether the feelings of the senses are like the external existing objects. Therefore it cannot rely on similarity to judge them[8].

Sextus Empiricus emphatically asserts that the intellect is incapable of distinguishing among impressions, those that faithfully represent objects from the external world and those that are distorted by the consciousness of the cognizing individual. The knowing

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[7] George E. Moore (1966), *Some Main Problem of Philosophy*, Collier Books Edition, New York, pp. 278-279.

[8] See: Benjamin Morison, *Sextus Empiricus, The Stanford Encyclopedia of Philosophy* (Fall 2019 Edition), Edward N. Zalta (ed.), https://plato.stanford.edu/entries/sextus-empiricus/, 4.1. *The criterion of truth.*

subject, in fact, has access only to their own impressions, and the cognitive process necessarily halts at them.

The complete unity of philosophy and science. The Greeks, fundamentally since the times of *Homer* (8th century BC) and *Hesiod* (9th century BC), were convinced of the unity of the entire reality based on the perception that the mutual interactions of all its elements manifested as an expression of one fundamental principle. This idea was distinctly articulated by the Ionian philosophers, who, however, could not agree on the essence of this principle. In this context, the thesis of the methodological identity of all inquiries into reality seems obvious. '*Philosophy*' from the etymological perspective, is the love of wisdom in the sense of seeking to understand the essence of everything that exists.

One could say that philosophy precedes all sciences in this sense, as it constitutes a collection of information providing a comprehensive and rational picture of the entire reality. *Ionian hylozoists* (6th and 5th centuries BC) formulated concepts that, regarding the structure of both inanimate and animate matter, in many respects, do not deviate too far from contemporary perspectives in the natural sciences. Ionian philosophy is the first historically documented example of the unity of philosophy and science.

In the 4th century BC, Plato contrasts common knowledge (*doxa*) with genuine knowledge (*episteme*), which he identifies with philosophical knowledge. Genuine knowledge was supposed to concern what truly exists, not just as appearance or illusion. And what truly exists are the immutable and eternal entities called Forms or Ideas. Plato's disciple, Aristotle, explicitly identifies science with philosophy and divides it - based on the criterion of application - into logic, theoretical philosophy, and practical philosophy.

Modern Philosophy of Consciousness

Soft essentialism. While in the case of *hard essentialism*, the essentialist analysis is global (applicable to any events) and direct, in the context of *soft essentialism*, the essentialist analysis is applied under certain conditions and indirectly. Within the realm of what's known as the *philosophy of consciousness*, it occurs only after a prior examination of the possibilities and cognitive limitations of any objects under investigation. If any doubts arise regarding these possibilities, the essentialist analysis becomes devoid of any meaning. It's challenging to speak about understanding something that is altogether unknowable, or when reliable ways of understanding that something are unknown.

R. Descartes (1596-1650), often referred to as the father of modern philosophy, made a profound breakthrough in the practice of philosophy. The starting point of his philosophy is the conviction regarding the unreliability of both the senses and reason in cognition. The senses mislead through various illusions, and philosophical and scientific systems, contradicting each other, also fail to provide certain knowledge. Only doubt can offer a secure foundation. One can doubt everything, except for one thing - one cannot doubt that one is doubting. The reasoning above can be presented in the form of the following syllogism: Doubting is thinking. Thinking requires a thinking subject. Therefore, since I am thinking, it means that I exist (*cogito, ergo sum*). Taking doubt as the starting point of philosophical thinking ultimately forced a paradigm shift, transitioning from the philosophy of being (*ontology*) to the philosophy of thinking (*epistemology*). Philosophy ceased to denote a theory of being as such and began to signify a theory of human knowledge.

In the philosophy of *Immanuel Kant* (1724-1804), the cognitive possibilities of humans are critically examined through the method of transcendental inquiry. The transcendental method involves exploring all the necessary conditions that enable the process of understanding reality; in other words, it enables the process of transcending (Latin: *transcender*e – to transcend) the limits of the subject in order to grasp the essence of the object. The transcendental method allows for a critical analysis of the cognitive faculties specific to various fields of knowledge and establishes the boundaries beyond which, due to the structure of the human mind itself, the competencies of the human intellect cannot extend.

Kant concluded that the source of necessary and universal knowledge, i.e., genuine knowledge, cannot be the senses or reason alone. Instead, the sources are, firstly, the forms of sensory intuition associated with the senses (the power of sensory perception - transcendental aesthetics) and, secondly, the forms of the intellect – *Verstand*, associated with the mind (the power of conceptualization - transcendental analytics). On the other hand, the source of metaphysical (philosophical) knowledge is the faculty of reason – *Vernunft* (the power of creating comprehensive views - transcendental dialectics), which can only provide apparent knowledge based on speculation and belief.

According to Kant's conviction, essential knowledge can be obtained, but under certain conditions (by applying the transcendental method) and indirectly (through the forms of sensory intuition and forms of the intellect).

Correspondence theory of truth. The Cartesian conception of truth (*evidentialist*) is directly focused on the correspondence of statements with the sphere of psychic experiences (clear and distinct), which are presumed to be adequate to the corresponding elements of objective reality. The measure of adequacy, and hence truth, is evidently clarity. In this sense, the *evidentialist-correspondence theory of truth* is subjective; the sense of obviousness and clarity is given only to the person experiencing it. An exit from total subjectivity may be found in intersubjectivity, considering the assumption of the similarity of human nature.

Immanuel Kant also maintains a correspondence understanding of truth in the so-called *transcendental logic*, seeing it as the conformity of thought with the object.

> If truth consists in the agreement of a cognition with its object, then this object must thereby be distinguished from others; for a cognition is false if it does not agree with the object to which it is related even if it contains something that could well be valid of other objects. Now a general criterion of truth would be that which was valid of all cognitions without any distinction among their objects[9].

According to Kant, general logic abstracts from any content of knowledge and considers only the logical form of cognitive acts in their mutual relation, in other words, the form of thinking in general. Unlike transcendental logic, within which truth concerning content makes sense, and whose field of operation is the field of objectivity or immediacy.

On the other hand, within the Kantian methodology, the transcendental problem of truth has been resolved relatively straightforwardly, as the solution lies within the realm of the phenomenal world:

> Taking something to be true' is an occurrence in our understanding that may rest on objective grounds, but that also requires subjective causes in the mind of him who judges. If it is valid for everyone merely as long as he has reason, then its ground is objectively sufficient, and in that

[9] Immanuel Kant (1998), *Critique of pure reason*, Cambridge University Press, p. 197.

> case taking something to be true is called *conviction*. If it has its ground only in the particular constitution of the subject, then it is called *persuasion*.
>
> Persuasion is a mere semblance, since the ground of the judgment, which lies solely in the subject, is held to be objective. Hence such a judgment also has only private validity, and this taking something to be true cannot be communicated. Truth, however, rests upon agreement with the object, with regard to which, consequently, the judgments of every understanding must agree (*consentientia uni tertio, consentiunt inter se*). The touchstone of whether taking something to be true is conviction or mere persuasion is therefore, externally, the possibility of communicating it and finding it to be valid for the reason of every human being to take it to be true; for in that case there is at least a presumption that the ground of the agreement of all judgments, regardless of the difference among the subjects, rests on the common ground, namely the object, with which they therefore all agree and through which the truth of the judgment is proved[10].

On the one hand, according to Kant, truth is based on objective and universal grounds (it applies objectively), and on the other hand, it also requires subjective reasons residing in the mind of the person judging truth and falsehood (it applies subjectively). In this case, the acceptance of something as true is called 'conviction' (*Überzeugung*). Kant contrasts it with so-called 'persuasion' (*Überredung*), in which the basis is solely the particular properties of the subject judging truth and falsehood; in this case, there is a lack of the objective and universal properties characteristic of *conviction*. *Persuasion* has only private validity, constituting an illusory semblance.

Partial Unity of Philosophy and Science. Sciences, especially the natural sciences, after their inception in ancient Greece and development in the Middle Ages, began to flourish in modern times, particularly in the 16th and 17th centuries:

> How the scientific revolution of the 16th and 17th centuries came about it easier to understand than the reason why it should have taken place at all. So far as the internal history of science is concerned, it came about by men asking questions within the range of an experimental answer, by limiting their inquiries to physical rather than metaphysical

[10] Ibidem, pp. 684-685.

> problems, concentrating their attention on accurate observation of the kinds of things there are in the natural world and the correlation of the behaviour of one with another rather than on their intrinsic natures, on proximate causes rather than substantial forms, and in particular on those aspects of the physical world which could be expressed in terms of mathematics. Those characteristics that could be weighed and measured could be compared, could be expressed as a length or number and thus represented in a ready-made system of geometry, arithmetic or algebra, in which consequences could be deduced revealing new relations between events which could then be verified by observation, The other aspects of matter were ignored[11].

Compared to ancient philosophy of being, in the period of modern philosophy of consciousness, several observations can be made: *firstly*, there is a shift in focus from investigating the internal nature of things to their mutual relationships; instead of delving into the essence of things, their description is undertaken (although a significant portion of philosophy during this time still dedicates thought to the essence of things). *Secondly*, there is a concentration on aspects of the physical world that can be expressed in the form of mathematical relationships. *Thirdly*, science seeks to solve specific problems, while philosophy allows situating these problems in a broader context, in the light of fundamental principles. Additionally, philosophy traditionally engages in the consideration of metaphysical problems, which are programmatically foreign to scientific inquiries.

Contemporary Philosophy of Language

Soft Anti-Essentialism. Philosophical analysis of essentialism is conducted through the prism of language. *The analytical conception of philosophy* maintains that the primary task of philosophy should be the analysis of the *structure of thought*. The appropriate method for analyzing this structure is the analysis of language. The secondary issue remains whether there are real counterparts that stand in an adequate relation to thought contents. Analytical philosophy, in the strict sense, primarily encompasses: *neorealism* (G.E. Moore), *logical atomism* (B. Russell, L. Wittgenstein I) and the *philosophy of ordinary language* (L. Wittgenstein II, J.L. Austin, G.

[11] A.C. Crombie (1922), *Augustine to Galileo,* vol. II, Science in the Later Middle Ages and Early Modern Times, XIII-XVII Centuries, Mercury Books, London, p. 121.

Ryle). It mainly focuses on language (both ordinary and scientific) and its relation to thought contents.

Logical atomism by Russell treats philosophy as a kind of analysis of the language of science; it is not science itself (in the sense of reflecting the broadly understood reality) but makes science possible. This is because, through the method of logical construction, it creates a formal language, especially so-called '*atoms of meaning*' for which specific sciences can seek corresponding elements in the real world, known as '*atomic facts*'. There is a clear relationship between these elements, which determines the possibility of adequate knowledge of reality.

Ludwig Wittgenstein I presents a radical form of logical atomism in his work *Tractatus Logico-Philosophicus* According to this view, all objects and states of affairs in the world are atomic facts that are mutually independent. Meaningful statements about the real world can only be made within the framework of the natural sciences. Philosophy, in this perspective, reduces solely to the analysis of language and the clarification of expressed propositions.

Ludwig Wittgenstein II, in his work *Philosophical Investigations* rejects the previously accepted propositions formulated in the spirit of logical atomism, as found in the *Tractatus Logico-Philosophicus* giving rise to the so-called *philosophy of ordinary language*. Wittgenstein still believes that most philosophical problems arise from a misunderstanding of the logic of language. However, he moves away from the belief that an artificial language based on formal logic can be an effective remedy. He believes that the language used by people does not mirror the logical structure of reality. Therefore, one should not inquire about the meanings of individual concepts but about their usage (*language use analysis* or *descriptive analysis*). The same concept takes on different meanings in different contexts. The meaning of a sentence lies in its use, and it is not some relation to something beyond it; by using language, we participate in various language games.

Semantic Theory of Truth. Among coherence-based concepts of truth (emphasizing logical consistency with other statements within a given system), one of the most significant is the so-called semantic definition of truth by *Alfred Tarski* (1901-1983):

> We shall now generalize the procedure which we have applied above. Let us consider an arbitrary sentence; we shall replace it by the letter 'p.' We form the name of this sentence and we replace it by another letter, say 'X.' We ask

> now what is the logical relation between the two sentences "X is true" and 'p.' It is clear that from the point of view of our basic conception of truth these sentences are equivalent. In other words, the following equivalence holds:
>
> (T) X is true if, and only if, p.
>
> We shall call any such equivalence (with 'p' replaced by any sentence of the language to which the word "true" refers, and 'X' replaced by a name of this sentence) an "*equivalence of the form* (T)."
>
> Now at last we are able to put into a precise form the conditions under which we will consider the usage and the definition of the term "*true*" as adequate from the material point of view: we wish to use the term "*true*" in such a way that all equivalences of the form (T) can be asserted, and *we shall call a definition of truth "adequate" if all these equivalence follow from it*.
>
> It should be emphasized that neither the expression (T) itself (which is not a sentence, but only a schema of a sentence) nor any particular instance of the form (T) can be regarded as a definition of truth. We can only say that every equivalence of the form (T) obtained by replacing 'p' by a particular sentence, and 'X' by a name of this sentence, may be considered a partial definition of truth, which explains wherein the truth of this one individual sentence consists. The general definition has to be in a certain sense, a logical conjunction of all these partial definitions[12].

A. Tarski decisively rejects carriers of truth such as *beliefs* or *judgments*. He takes a proposition as the carrier of truth, understood as a specific sequence of linguistic signs. The distinction between *object language* and *metalanguage*, introduced by Stanisław Leśniewski (1886-1939), allowed Tarski to formulate a concept of truth that is resistant to any antinomies. Logical value (truth and falsity) is a characteristic of propositions that can only be expressed in an external language (*metalanguage*) in relation to the language in which these propositions are expressed (object language). For example, the proposition in quotes 'the ball is round' (*metalanguage* - the language in which one speaks) is true always and only if the ball is round (*object language* - the language about which one speaks).

A. Tarski introduced the concept of truth as a property of declarative sentences that function as a metalanguage with respect to

[12] Alfred Tarski, *The Semantic Conception of Truth: and the Foundation of Semantics* [in:] *Philosophy and Phenomenological Research*, Vol. 4, No. 3 (Mar., 1944, pp. 341-376), p. 344.

the language in which these sentences are uttered (object language). This leads to the conclusion that true propositions can only be formulated (substantively accurately and formally correctly) within and in relation to some language, which means that it inherently has a limited scope. Tarski thus rejects the possibility of formulating a general definition of a true proposition. True in a certain sense is only the set of all those sentences that can be obtained from the schema: *T: X is true if, and only if, p.* The set of such sentences, assuming that the given language is a closed language (composed of a finite number of sentences), would sufficiently characterize the content of the term '*true proposition*' as each of them could be treated as a partial definition of this term.

However, languages (including formal ones) are not finite, and therefore, Tarski refines his concept by recognizing that propositions result from operations on propositional functions, and these take on a hierarchical form from simple to increasingly complex.

Fundamental chapter of philosophy and science. According to *G.E. Moore*, the fundamental task of philosophy is the analysis of ways of acquiring knowledge about the world, and the only, as he believes, meaningful way is the analysis of the language people use. Common-sense knowledge held by people in general essentially contains the truth about the real world. Of course, recognizing details, their mutual connections, and potential developmental trends require specialized skills. The specific task of the proposed philosophy thus comes down to critically considering knowledge obtained through *common sense*, contained in linguistic expressions, and critically considering the views of philosophers that are in contradiction with this knowledge. Therefore, nothing prevents us from acknowledging that the only research subject for a realist philosopher should be a detailed analysis of linguistic expressions, regardless of the field of knowledge in which they are formulated. However, something entirely different is science in the broadest sense - language is only a necessary tool for it in the process of commonsensical representation of reality, which is the proper subject of scientific research.

For *B. Russell*, similar to Moore, the proper and only meaningful philosophical method is linguistic analysis. However, the analysis proposed by Russell significantly differs from the one suggested by Moore. While Moore attributed a special role to common sense and the analysis of ordinary language, Russell is inclined to consider philosophy as a discipline more related to *science* than common-sense knowledge. For this reason, his analysis employs precise logical techniques and has a scientific character; it is, namely, logical analysis.

L. Wittgenstein II, in *Philosophical Investigations*, rejects the previously formulated theses found in *Tractatus Logico*-Philosophicus (I). Although he still acknowledges that *the limits of my language define the limits of my world*, language loses its reference to objects, ceasing to mirror the logical structure of reality. In his view, philosophy cannot seek an ideal language of science capable of eliminating all ambiguities and individual biases of ordinary language, thus solving philosophical problems. Traditional problems of philosophy can indeed be easily resolved, but under the condition that we answer the following question: how and in what circumstances do we use words and sentences? It turns out that by using language, we participate in *linguistic games*:

> We can also think of the whole process of using words in (2) as one of those games by means of which children learn their native language. I will call these games "language-games" and will sometimes speak of a primitive language as a language-game. (…)
>
> I shall also call the whole, consisting of language and the actions into which it is woven, the "language-game"[13].

The nature of these games depends solely on the community in which they are employed; they have no objective reference. The meaning of a sentence lies in its use, not in a certain relation to something beyond it. It is only the prevailing opinion in a given community that deems one usage correct and another incorrect. A philosopher should investigate language exclusively in its social context, i.e., in the context of communication within a specific community. If they fail to do so and use language outside its social context, they fall into linguistic confusion and mental deviation, and consequently, into metaphysics by creating imaginary entities as equivalents of linguistic forms. Classical philosophical problems turn out to be mostly *pseudo-problems*. Therefore, philosophy should serve a *therapeutic function* and demonstrate how to use language correctly to avoid generating pseudo-problems.

According to *J.L. Austin* (1911-1960), philosophy is nothing more than analysis, by which he means the semiotic description[14] of

[13] Ludwig Wittgenstein (1986), *Philosophical Investigations*, translated by G.E.M. Anscombe, Basil Blackwell Ltd, p. 5.

[14] See: Władysław W. Skarbek (2010), *Logika dla Humanistów* (Logic for Humanists), NWP, pp. 18-24.

linguistic expressions in various contexts and the detection of relationships between them. Semiotic description includes syntactic functions (*formation and transformation*), semantic functions (*designation, denotation, connotation*), and pragmatic functions (*creative, perceptual, interpretive, expressive, declarative, psycho-volitional, behavioural, and performative*).

Sociocultural Constructivism

Hard anti-essentialism. Especially two philosophical currents explicitly oppose essentialism, traditional philosophy, and science. These are American *neopragmatism* (Hilary Putnam: 1926-2016) and *deconstructionism* (Jacques Derrida: 1930-2004).

H. Putnam strongly fought against essentialism in philosophy. He accepted two philosophical positions as its essential parts: *first*, the position of realism, which he called *metaphysical realism*, and *second*, the position related to the issue of truth, namely, the *correspondence theory of truth*. In the work *Reason, Truth, and History* Putnam talks about the externalist perspective, which he then contrasts with the internalist perspective:

> One of these perspectives is the perspective of metaphysical realism. On this perspective, the world consists of some fixed totality of mind-independent objects. There is exactly one true and complete description of 'the way the world is'. Truth involves some sort of correspondence relation between words or thought-signs and external things and sets of things. I shall call this perspectives the externalist perspective, because its favourite point of view is a God's Eye point of view.
>
> The perspective I shall defend of has no unambiguous name. (…) I shall refer to it as the internalist perspective, because it is characteristic of this view to hold that what objects does the world consist of? Is a question that it only makes sense to ask within a theory or description[15].

Metaphysical realism, in Putnam's understanding, is characterized by the belief in the existence of an external world entirely independent of the senses and reason of humans. The knowing subject in the act of cognition always turns toward something that exists beyond it, toward objects that exist independently of it (*externalist perspective*). Even if the subject cannot know the world as it really is, this does not in any way

[15] Hilary Putnam (1981), *Reason, Truth and History*, Cambridge University Press, p. 49.

undermine the conviction that such a world exists. In the realm of metaphysical realism, there is a strict correspondence between the statements formulated by the knowing subject and the reality external to it (correspondence theory of truth).

Contrary to metaphysical realism, Putnam defended a position he called *internal realism* (*internalist perspective*). Describing it, Putnam refers to the concept of so-called *conceptual relativity* - there is no one correct sense of concepts such as 'existence,' 'individual,' or 'object.' The world can be described using different conceptual systems adopted for certain reasons by the knowing subject. The idea of the existence of a *reality in itself* independent of the knowing subject is simply meaningless. The consequence of such an approach is a break with the correspondence theory of truth (he criticized, among others, A. Tarski's concept of truth).

Jacques Derrida's *deconstructionism* involves questioning, unmasking, and dismantling traditional distinctions and conceptual hierarchies in philosophy because, according to deconstructionists, they have nothing to do with truth and, worse, threaten human freedom. Moreover, deconstructionism appeals to the achievements of contemporary logic and the natural sciences, which supposedly invalidate essentialist approaches. As an example, in this context, concepts such as multi-valued logics, fuzzy sets, the Löwenheim-Skolem theorem (infinitely many interpretations of any set of axioms), chaos theory, or catastrophe theory are mentioned.

Non-classical theories of truth. If in the classical (correspondence) conception of truth the cognitive relation is understood as a kind of spatial relation (conformity of thought to reality) instead of being understood as a specific intentional relation, then the relationship of correspondence becomes unclear and inoperative. As a result, the classical (coherence) theory of truth is rejected in favour of the so-called non-classical theories.

Among the more well-known ones are the following: evidentialist, universal agreement, coherence, and pragmatic. *Evidentialis*t (Descartes, H. Rickert) – a proposition is true when we feel that it is in accordance with a certain norm by virtue of obviousness, and on this basis, we should accept it (the proposition is compared with our own sphere of experiences). *Universal agreement* (Charles S. Peirce) – a proposition is true if its components would be successively confirmed in an infinite process of inquiry (this does not concern the current agreement of researchers). *Coherence* (F.H. Bradley) – truth consists in the coherence of propositions with each other (a coherent and non-contradictory system of propositions in given circumstances). *Pragmatic* – true propositions are those that bring benefit in action (truth is subordinated to utility).

One of the interesting contemporary non-classical conceptions of truth is the one proposed by the anti-essentialist *H. Putnam*. Since he shifted to the position of *internal realism* (abandoning so-called metaphysical realism), he began to develop his own conception of truth understood as an *idealization of rational acceptability*:

> To reject the idea that there is a coherent 'external' perspective, a theory which is simply true 'in itself, apart from all possible observers, is not to identify truth with rational acceptability. Truth cannot simply be rational acceptability for one fundamental reason; truth is supposed to be a property of a statement that cannot be lost, whereas justification can be lost. The statement The earth is flat' was, very likely, rationally acceptable 3,000 years ago; but it is not rationally acceptable today. (…)
> What this shows, in my opinion, is not that the externalist view is right after all, but that truth is an *idealization* of rational acceptability. We speak as if there were such things as epistemically ideal conditions, and we call a statement 'true' if it would be justified under such conditions[16].

While '*epistemically ideal conditions'* are essentially unattainable, we can approximate them to a very high degree. Thus, within *internal realism*, the classical correspondence theory of truth is replaced by the idea of judging something under ideal cognitive conditions, taking into account specific conceptual frameworks. The idealization in question can be somewhat likened to *ideal constructs* in the natural sciences, such as a perfect black body or a frictionless surface.

Concluding Kant's considerations regarding truth, Putnam states:

> As I have said, the only answer that one can extract from Kant's writing is this: a piece of knowledge (i.e. a 'true statement') is a statement that a rational being would accept on sufficient experience of the kind that is actually possible for beings with our nature to have. 'Truth' in any other sense is inaccessible to us and inconceivable by us. Truth is ultimate goodness of it[17].

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[16] Ibidem, p. 55.

[17] Ibidem, p. 64.

Putnam's concept of truth[18] aligns with his anti-essentialism. It questions two fundamental propositions related to essentialism (and, consequently, the correspondence theory of truth): first, the logical value of statements is determined by a reality independent of the knowing subject, and second, the correspondence relation connects a statement with precisely one part of reality, namely, the one about which the statement makes a claim.

Philosophy and Antiphilosophy. It is necessary to distinguish between two types of conceptions of philosophy, ways of understanding it, and, consequently, ways of practicing it. The first type is *traditional conceptions of philosophy* (ancient, scholastic, modern, positivist, linguistic, and irrationalist), and the second type is the *constructivist type*, which I identify with antiphilosophy.

Ancient Conception of Philosophy (Classical and Anthropocentric variant). *Classical* - philosophy is rational, disinterested knowledge about the true reality (Plato) and about the ultimate causes and purposes of being (Aristotle), encompassing everything that exists in one way or another (real, abstract). *Anthropocentric* - philosophy is the art of life, wisdom for living, an in-depth way of shaping a high-quality life. For example, Epicureanism represents the ideal of a happy person; Stoicism - the ideal of a self-disciplined person living in harmony with nature, while scepticism represents the ideal of intellectual caution.

Scholastic Concept of Philosophy (Theocentric and Dialectical Variations). *Theocentric* - scholastic philosophy, in its theocentric form, serves theology (*ancilla theologiae*). Its role is confined to providing rational arguments that reinforce and justify revealed knowledge. *Dialectical* - scholastic philosophy, in its dialectical form, is tantamount to the ability to analyze words in a manner that, through grasping their attributed meanings, one can acquire knowledge of the essence of things. The essence of things is reached through the analysis of words.

Modern philosophy (Empiricist and Rationalist variations). *Empiricist* - philosophy (natural philosophy) is knowledge about things, their structure, properties, and manifestations (e.g., Fr. Bacon, Th. Hobbes, J. Locke). *Rationalist* - philosophy is knowledge based on the process of reasoning and boils

[18] It should be emphasized that the discussed concept of truth in the understanding of H. Putnam is not the only one proposed by him. It evolves in accordance with his changing conceptions of realism. However, it is not our task to analyze them at this point.

down to the process of generalizing individual data, i.e., deriving regularities concerning all facts based on individual events or facts.

Positivist Conception of Philosophy (Varieties: including classical positivism, neopositivism, contemporary philosophy of language). *Classical Positivism* **- p**hilosophy serves as a synthesis (generalization) of the results of specific sciences according to a fundamental idea, such as the idea of progress, cyclicality, or evolution. This concept is associated with scientism, the view that the exemplary form of human knowledge is the mathematical and natural sciences (Auguste Comte). *Neopositivism* **-** the concept put forward by the members of the Vienna Circle (Rudolf Carnap, Moritz Schlick). Philosophy is exclusively the analysis of the language of science, including its syntax, meaning, rules of construction, and inferences. There are formal sciences (analytic-tautological statements) and empirical sciences (synthetic statements, the result of empirical research procedures). All statements outside the scope of these sciences are considered metaphysical and devoid of meaning. *Contemporary Philosophy of Language* (Linguistic Analysis*)* **-** philosophy is reduced solely to the analysis of language at any level, including everyday language, scientific language, or philosophical language. Traditional philosophical problems very often (if not exclusively) turn out to be linguistic problems.

Irrationalist Conception of Philosophy - according to this conception, philosophy is a way of being for humans in the world through the synthetic meaningfulness of the world. It is a way of familiarizing oneself with the world or coming to terms with the world. Therefore, philosophy is a collection of all self-awareness processes that give meaning to human existence in the world.

Constructivist Conception of Philosophy (Antiphilosophy) – the concepts mentioned above (except for the irrationalist one) are based on essentialism (hard or soft) and either explicitly support the traditional (*correspondence*) theory of truth or question its significance without excluding the possibility of its existence (e.g., *evidentialist* or *coherency* conception).

On the other hand, the constructivist conception of philosophy firmly rejects essentialism (*hard anti-essentialism*) and the traditional (*correspondence*) theory of truth (e.g., H. Putnam). This total opposition to traditional philosophy, its attempts to reach the essence of reality, and its true representation do not deserve the name of philosophy; this is precisely what is referred to as *antiphilosophy*.

1.2. Assumptions Regarding Scientific Theories

Regarding scientific theories, one can adopt, for example, the following assumptions (Table 1.2.).

Ontological		***Epistemological***		***Methodological***	
Criterion	*Division*	*Criterion*	*Division*	*Criterion*	*Division*
Relation of whole to part	Partialness	Sources of Scientific Knowledge	Genetic Empirism	Principles of Scientificity	Science
					Pseudoscience
	Holism		Genetic Rationalism		Protoscience
Dispute over facts		Limits of Scientific Knowledge	Immanent Externalism	Character of Scientific Theories	Descriptivism
			Immanent Internalism		Instrumentalism
			Transcendent Eternalism		Realism
			Transcendent Internalism		

Table 1.2. Philosophical Assumptions In Scientific Theories

Ontological assumptions

Relation of Whole to Part. Two possibilities may occur, either the primacy lies with the parts over the whole (*partialness*), or conversely – the primacy lies with the whole in relation to its parts (*holism*).

Partialness – a position treating the properties of any whole's components as primary in relation to the properties of the whole of which they are constituents. The properties of the whole are entirely reducible to the properties of its component parts. A related position is reductionism – in which it is assumed that explaining what an object, phenomenon, or process is requires reference to the simplest elementary components of the object, phenomenon, or process.

Therefore, the investigation should begin by understanding what is simple, and then gradually progress to the wholes that are more complex (analytical approach).

Holism – a position treating the properties of any whole as irreducible to the properties of its individual constituent parts. Holism makes sense not only in the philosophy of language and in the general theory of science but also, among other fields, in the social and historical sciences. Society is treated in these sciences as a higher-order system than its individual elements. On the contrary, methodological individualism (K.R. Popper refers to it as *historicism*) is the opposite of holism in these sciences. A related concept is the *theory-system approach* – recognizing a given object, phenomenon, or process as complex, then decomposing (dividing) it until the object, phenomenon, or process can be considered elementary. After decomposition, all essential relationships are established (analysis and synthesis of the relational network).

Dispute over Facts: The foundation of all empirical sciences (natural and humanistic) lies in facts, in the sense that scientific inquiry begins with them, and results are verified through their examination. The concept of a fact played a fundamental role in certain philosophical systems. *L. Wittgenstein* (1889-1951) even initiates his *Tractatus Logico-Philosophicus* with the significant thesis that *1. The world is everything that is the case. 1.1. The world is the totality of facts, not of things*. Similarly, the Polish philosopher and praxeologist *T. Kotarbiński* (1886-1981) considers facts as fundamental ontic categories. He then divides them into *static* (things) and *kinetic* (events). In his reistic ontology, however, he treats things as fundamental, primary constituents of the ontic universe.

The immediate question that arises, however, is whether science is interested in facts themselves or rather in systematically recurring relationships between facts, enabling the prediction of future facts based on the knowledge of current facts. Accurate prediction would simultaneously serve as the verification of hypotheses formulated based on a set of facts.

The discussion carried out by *neopositivists* within the Vienna Circle is instructive in this regard. They gave a sharp dichotomy to sentence division into empirical and theoretical categories: sentences can only be expressed either in reference to facts (empirical) or as tautologies. Among empirical sentences, a special role is played by the so-called *elementary sentences* (observational, protocol, atomic), which account for direct sensory experiences that mirror facts. The logical schema describing the comprehensive set of facts, ultimately reducible to a set of elementary sentences, forms a scientific theory. This was an elaboration of Ludwig Wittgenstein's concept, from whom neopositivists drew inspiration, contained in propositions 4.25 and 4.26 of the *Tractatus*:

> 4.25 P/M [→GER | →OGD]
> If an elementary proposition is true, the state of affairs exists: if an elementary proposition is false, the state of affairs does not exist.
> 4.26 P/M [→GER | →OGD]
> If all true elementary propositions are given, the result is a complete description of the world. The world is completely described by giving all elementary propositions, and adding which of them are true and which false[19].

As a result of intensively conducted discussions, neopositivists eventually abandoned the belief that every theory can be reduced to a set of elementary sentences. This is impossible because in every theory, a fragment expressed in theoretical sentences is equally essential as empirical experience. Without this fragment, the theory would not be a logical structure adequately reflecting reality. Furthermore, the following question arises: should the term ‘*fact*’ be understood as something belonging to non-linguistic reality, or as a sentence - a component of linguistic reality - affirming the existence of a specific ontological moment. At this point, however, we will not analyze this issue.

E p i s t e m o l o g i c a l a s s u m p t i o n s

Sources of knowledge. It is commonly accepted that sources of knowledge can be either the senses or reason.

Genetic empiricism asserts that all knowledge originates from the senses; the knowing subject engages in cognitive contact with reality through them.

Genetic rationalism, on the other hand, posits that all valuable knowledge has its source in reason, while the senses play no significant role in the process of cognition.

Limits of Scientific Knowledge. The issue concerns whether the knowing subject, in the act of cognition, is capable of surpassing its own boundaries. In other words, it explores the possibility and extent

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[19] Ludwig Wittgenstein (1922), *Tractatus LogicoPphilosophicus*, Kegan Paul (London), Side-by-Side-by-Side Edition, http://people.umass.edu/klement/tlp/

to which the apprehending subject can understand a transcendent reality (external) beyond itself. The answers to these questions, however, depend on the way one comprehends this transcendent reality, which, in the context of cognition, can be referred to as the *transcendent object*. There are at least two understandings of this concept[20].

The first understanding involves defining a transcendent object as any entity not constituting an experience of the knowing subject, i.e., existing beyond the immanent sphere of the knowing subject. Consequently, there can be two resolutions: immanent externalism or immanent internalism. *Immanent externalism* accepts the possibility of transcending the immanent sphere in the act of cognition. *Immanent internalism* denies the possibility of surpassing the sphere of immanence; the cognitive act remains within the realm of the experiences of the knowing subject.

The second understanding involves defining a transcendent object as any entity not being a mental construction (i.e., an intelligible object), meaning it exists independently of any mental constructs of the knowing subject. Consequently, there can be two resolutions again: transcendent externalism or transcendent internalism. *Transcendent externalism* accepts the possibility of knowing external objects in the cognitive act as they are. *Transcendent internalism* denies the possibility of knowing external objects; the cognitive act remains within the mental constructs of the knowing subject.

Methodological assumptions

Principles of Scientificity. Scientific knowledge (science) is characterized by, *firstly*, allowing only the possibility of empirical (sensory) and rational (reason) cognition, and *secondly*, collectively fulfilling three principles of scientificity[21]: intersubjective communicability, intersubjective testability, and the rationality of accepting beliefs.

Intersubjective Communicability - knowledge can be conveyed to another conscious subject and understood by them, provided they have the necessary qualifications.

Intersubjective Testability - there is the possibility of testimony, i.e., demonstrating the truth or a correspondingly high probability in relation to a set of information constituting knowledge about any

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[20] See: Władysław W. Skarbek (2000), *Elementy filozofii* (The Elements of Philosophy), NWP, pp. 245-246.

[21] See: Władysław W. Skarbek (2013), *Wybrane zagadnienia metodologii nauk społecznych* (Selected Issues in General Sociology and Sociology of Education), NWP, pp. 13-15.

events. Alternatively, there is the possibility of falsification, i.e., demonstrating falsehood or a correspondingly low probability in relation to a set of information constituting knowledge about any events.

Rational Acceptance of Beliefs - the degree of conviction with which a proposition is asserted should not exceed the degree of its justification.

Logical Positivism (Vienna Circle) posed the so-called *demarcation problem,* which involves distinguishing scientific statements from non-scientific ones. In simplified terms, it was acknowledged that scientific knowledge (theory) should consist of statements that can be empirically tested. K.R. Popper (1902-1994) proposed a criterion of demarcation based on the asymmetry between the *verification* (confirmation of truth) and *falsification* (demonstration of falsehood) of scientific claims (theories, laws). He specifically emphasized that instances confirming a statement in experience do not guarantee its truth, whereas the occurrence of even one case conflicting with a given statement demonstrates its falsehood.

A satisfactory resolution to the demarcation problem becomes significant when we consider the phenomenon of so-called *pseudoscience* within the realm of knowledge. Pseudoscience refers to a kind of knowledge that aspires to be recognized as scientific, either underestimated by official science according to pseudoscientists, or seeking the status of so-called *alternative knowledge*. The set of statements proclaimed within pseudoscience may adhere to the principle of intersubjective communicability but does not meet the other two principles: intersubjective testability and the rational acceptance of beliefs. Pseudoscience, in particular, focuses on phenomena such as the existence or acknowledgment by official science of '*supernatural forces*' like precognition, the ability to move matter with the power of the mind (psychokinesis), direct communication between minds (telepathy), sensing water or other objects underground (dowsing), diagnosing and treating illnesses with psychic powers (including psychic surgery), and so on. However, in addition to phenomena that contradict not only science but even common sense (e.g., spiritualism), there are areas of knowledge that are either not yet recognized or lack currently sufficient experimental evidence, although they adhere to the research procedures proper to science (so-called *protoscience*). Caution must be exercised in this regard.

Character of Scientific Theories. By scientific theory[22], we will understand a logical whole that includes the following elements:

1. Scientific statements (among them hypotheses and laws of science); the sentences from which they are constructed must contain at least one theoretical term, i.e., a term denoting an unobservable property.

2. Models reflecting the studied portion of reality.

3. The procedure for testing the theory on a scale: verification-falsification.

The cognitive status of a theory - meaning whether theories (especially the theoretical statements forming scientific statements) have logical value: true or false - determines the way scientific theory is understood. Three basic concepts can be distinguished: descriptive, instrumentalist, and realistic.

Descriptive Concept of Scientific Theory – the theory describes the course of observable events in a manner that is as simple and economical as possible. It seeks to capture the relationships between individual events and their properties. The theory itself, or more precisely, the theoretical statements that constitute it, does not have logical value; it is neither true nor false. Nevertheless, since the theory describes observable events and there is a credible procedure for observing them, it is possible to translate theoretical statements into factual statements (about facts), which do have logical value. In practice, however, it is difficult to make an unambiguous translation of each theoretical statement into a factual statement. Therefore, a weakened condition is accepted, according to which a given theoretical statement corresponds not to a single factual statement but to a certain set of logically equivalent factual statements.

Instrumentalist Concept of Scientific Theory – a theory, even if entirely correct, does not describe anything, and therefore the statements that compose it are not subject to logical qualification (they are neither true nor false). The theory serves only as a tool for systematizing events (*systematizing function*) and predicting future events based on past ones (*predictive function*). The statements of the theory are not logical sentences, and hence, they cannot be applied as premises to explain some observational (factual) statements. Treating the theory as a set of symbolic rules representing experiential data is equivalent to denying its explanatory function and thus the justification for formulating scientific laws within it, as these laws

[22] Ibidem, pp. 29-32.

inherently require fulfilling not only a predictive function but also - importantly - an *explanatory function*.

Realistic Concept of Scientific Theory - the theory describes the properties (general and specific) of empirical reality (especially social reality). In this case, it can be an adequate linguistic reflection of objective reality, external to the knowing subject. Therefore, the theory - as long as it meets the requirement of empirical testing (*verification or falsification*) - is a set of factual statements: either true or false.

1.3. Assumptions of Axioeventism

With regard to axioeventism, the following assumptions are made:

ASSUMPTION 1. *Total Reality* (TR) consists of two dimensions: Ontic Universe (OU) and Reality of Abstract-Essential Structures (RAES). *Ontic Universe* (OU) is considered in three planes of significance: *structural-stati*c (natural, mental, social reality and potential essential structures), *structural-dynamic* (informational, eventful, axiological and temporal interactions), and *structural-result* (information, events, values and time). On the other hand, *Reality of Abstract-Essential Structure*s (RAES) encompasses: mathematical objects, scientific idealisation and universals (positive and negative) (Table 1.3.).

TOTAL REALITY	**Ontic Universe**	Structural-static Plane	Natural Reality
			Psychic Reality
			Social Reality
		Structural-dynamic Plane	Informational Interactions
			Eventistic Interactions
			Axiocreative Interactions
			Temporal Interactions
		Structural-result Plane	Information
			Events
			Values

			Time
	Reality of Abstract-Essential Structures	Mathematics Objects	
		Scientific Idealisations	
		Universals	Positive
			Negative

Table 1.3. Planes of the Total Reality

ASSUMPTION 2. *Situationist Essentialism*. Essentialism is the perspective acknowledging the existence of a strictly defined set of properties and relations inherent in any objects, phenomena, or processes, which unambiguously defines their essence. On the other hand, *situationist essentialism* is essentialism relativized to strictly defined ontic situations in any fragments of the planes of the *Ontic Universe* (OU).

ASSUMPTION 3. *Systemic Approach* - every fragment of the ontic universe, at any level, is considered as a *Relatively Isolated System* (RIS), subject to proliferation towards integration (*positive proliferation*) or disintegration (*negative proliferation*).

Within the framework of the aforementioned assumptions, the term 'axioeventism' is defined as:

> **<u>Def. 1.1.</u> *Axioeventism* – 1. *Ontic Universe*: (OU: natural, psychic and, social reality) is characterized by four equivalent types of interactions: informational, eventistic, axiocreative and temporal, which generate, respectively: information, events, values and time. Each fragment of the Ontic Universe constitutes a *Relatively Isolated System* (RIS), subject to positive or negative proliferation. 2. *Reality of Abstract-Essential Structures* (RAES: mathematical objects, scientific idealisations and universals) is characterized by five properties: atemporality, aspatiality, staticity, self-existence and passive potentiality.**

According to the definition of axioeventism, the *Ontic Universe* (OU) is a unique space of four types of interactions (informational, eventistic, axiocreative and temporal), forming various *Relatively*

Isolated Systems (RIS). From the perspective of a conscious observer, these interactions manifest as information, events, values, and time, composing the natural, psychic and social reality. All interactions in the stream of mutual interplays aim towards integrative positive proliferation or disintegrative negative proliferation.

The term 'axioeventism' itself is of a hybrid nature (Greek: *axios* - valuable, Latin: *eventum* - event) and was coined to emphasize the equality of the value dimension with the other dimensions: informational, eventful, and temporal, which have dominated previous ontologies.

2. STATICS AND DYNAMICS OF RELATIVELY ISOLATED SYSTEMS

2.1. Systemic Approach

The two concepts to be distinguished are 'systemic approach' and 'holistic approach' as they are not synonymous. The *holistic approach* involves recognizing the primacy of the whole over its part:

> Holism. Any doctrine emphasizing the priority of a whole over its parts. In the philosophy of language, this becomes the claim that the meaning of an individual word or sentence can only be understood in terms of its relations to an indefinitely larger body of language, such as a whole theory, or even a whole language or form of life. In the philosophy of mind, a mental state similarly may be identified only in terms of its relations with others. Moderate holism may allow that other things besides these relationships also count; extreme holism would hold that the network of relationships is all that we have. A holistic view of science holds that experience only confirms or disconfirms large bodies of doctrine, impinging at the edges, and leaving some leeway over the adjustments that it requires (see Duhem thesis)[23].

The *systemic approach*, on the other hand, is a way of thinking and problem-solving in which phenomena are considered comprehensively due to internal dependencies and relationships with the environment. Problems are examined from different perspectives and on different levels; decomposition of studied objects into qualitatively distinct elements is applied, taking into account the connections between hierarchically situated elements (subsystem - supersystem). At the same time, in the systemic approach, particular attention is paid to the differences in properties that apply to certain wholes (individual systems, i.e., subsystems and supersystems) over their component parts, which may be individual elements or subsystems. In particular, these differences can be alternative in nature – either the primacy of the whole over the parts (*holism*) or, conversely, the primacy of the parts over the whole (*partialness*).

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[23] Simon Blackburn (1996), *The Oxford Dictionary of Philosophy*, Oxford University Press, p. 177.

Until the development of the general theory of systems, approximately until 1945, science focused on individual elements (such as atoms in physics, cells in biology, needs in psychology) and sought causal relationships to explain observed phenomena. Since World War II, science has been exploring certain wholes referred to as *systems* or *arrangements*, which possess two fundamental properties: 1) the behaviour of each element influences the behaviour of the whole, but no single element has a decisive influence on the whole; 2) any subset of elements influences the whole, but no subset has a decisive influence on the whole.

Among proponents of the systems theory approach, there is a lack of universally accepted definition for the concept of 'system.' Some refer to systems in terms of certain classes of mathematical models, while others associate them with terms such as 'element,' 'whole,' 'property,' or 'feedback.' Yet, others characterize systems through terms like 'control,' 'input,' 'output,' etc. One of the founders of systems theory, Ludwig von Bertalanffy, distinguishes three fundamental types of systems in his view:

> We may first distinguish *real systems*, that is, entities perceived in or inferred from observation and existing independently of an observer. On the other hand there are *conceptual systems*, such as logic or mathematics, which essentially are symbolic construct (but also including, e.g., music); with abstracted systems (science) as a subclasss, that is, *conceptual systems* corresponding with reality. However is by no means as sharp as it would appear[24].

The above distinction clearly illustrates the broad spectrum of systems within the scope of systems theory.

Another crucial issue is undoubtedly the *ontological status of a system* in its logical-formal aspect. This pertains to whether a system should be conceptualized as a set in a *collective* (mereological) sense or rather in a *distributive* sense (set-theoretical). The creator of *mereology*, where the fundamental concept is the notion of a collective set (*mereological*), as opposed to a distributive set (set-theoretical), is the Polish logician *Stanisław Leśniewski* (1886-1939):

> In his theory Leśniewski decidedly opposes to the fact that empty classes exist. In other words, at mereology it cannot be said of any classes, which don't consist of

[24] Ludwig von Bertalanffy, *The History and Status of General Systems Theory*, in: The Academy of Management Journal, Vol. 15, No. 4, General Systems Theory (Dec., 1972), pp. 421-422.

> elements. For the reason that sets are some entities in their collective sense, a formal theory of a set may be interpreted in a physical and to–become–realized way. Any parts of concrete objects are their physical parts. We cannot identify the formal theory with its physical and to–become–realized interpretation.
>
> Mereology is a theory which concerns its relations and these relations characterize objects consisting of parts, irrespective of material objects and their parts' nature. Mereology was used to describe the structure of expressions understood as physical objects (entities) consisting of parts. The language of metalogics of protothetics and ontology systems, which is built in copmplance with semantic rules of parts-and-collective-sets theories[25].

It seems obvious that in the broad sense of reality (ontological universe), there are both systems that can be regarded as a collective set (e.g., a car composed of a set of individual parts) and those that meet the conditions of a distributive set (e.g., a set of cars composed only of individual cars). To answer the question of whether, for cognitive and methodological reasons, it is better to construct the term 'system' using the concept of a set in a collective or distributive sense, it is necessary to clarify both of these concepts[26]:

> **Def. 2.1.** ***A collective set*** **is an aggregate composed of components, which are any heterogeneous concrete objects, meeting the following three postulates: indistinguishability of the set from its own component, transitivity, and asymmetry between components that are different from each other.**

1. Every collective set is its own component.
2. Transitivity occurs among the components of a collective set.
3. Asymmetry exists between different components of a collective set.

Let's take the following example. If the speedometer (*x*) is a component of the dashboard (*y*), then the dashboard (y) is not a component of the speedometer (*x*). The term '*set*' used in a *collective sense* refers to objects composed of different parts (components). Therefore, a car is a collective set when we treat it as an aggregate

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[25] https://www.researchgate.net/publication/313881185_The_Philosophy_of_Stanislaw_Lesniewski

[26] Władysław W. Skarbek (2010), *Logika dla humanistów* (Logic For Humanists), NWP. p. 137 and following.

composed of wheels, chassis, body, windows, etc., which are concrete objects that are heterogeneous to each other.

On the other hand, set theory, also known as the *logical-mathematical theory of sets*, deals with sets understood differently; these are specifically called *distributive sets*, whose constitutive parts are referred to as elements. The creator of the theory of distributive sets (set-theoretical) is *George Cantor* (1845-1918):

> **Def. 2.2. *A distributive set* (set-theoretical) is a collection of arbitrary objects distinguished in such a way that three following postulates are maintained: abstractness, extensionality, and distinguishability of the set from its own element.**

1. *The abstractness of a set* - *x* belonging to set *M* means that *x* is an element of *M*. If: *M* is the set of law students, *x* is Jan, who is a law student, then the expression '*Jan belongs to the set of students'* means 'that '*Jan is a student'*.

2. *Extensionality of a set* - two sets that have the same elements are equal: $[A = B \Leftrightarrow \bigwedge_x (x \in A \Leftrightarrow x \in B)]$. For example, we have a set consisting of three numbers: {4, 5, 6} = {4, 5, 6, 4, 5, 6}.

3. *Distinguishability of a set from its own element* - a set differs from its own element in the sense that a set cannot be its own element.

The following comparison highlights more detailed essential differences between sets in a *collective* (mereological) sense and sets in a *distributive* (set-theoretical) sense:

Distributive Set	Collective Set
1. *Abstractness of a set* - every element belongs to the same type as the set itself; for example, only numbers belong to the set of numbers.	1. Non-abstractness of a set - a consequence of understanding components as non-homogeneous objects.
2. *Extensionality of a set* - the multiple occurrences of the same elements do not affect their cardinality (size); for example, two sets {Jan, Piotr} and {Jan, Jan, Piotr, Piotr} have the same cardinality.	2. *Non-extensionality of a set* - a consequence of understanding components as specific objects; several components, even if homogeneous, are not the same as one component.

3. *Distinguishability of a set from its own element* - no distributive set is simultaneously its own element. The opposing stance leads to the so-called *Russell's paradox*. For instance, the set of cars (especially a singleton set) is not a car.	3. *The indistinguishability of a set from its own component* - is a consequence of conceiving components as concrete objects; each collective set is simultaneously its own component. For example, a car is simultaneously its own component, i.e., a component of the car.
4. *Intransitivity* - the relation of being an *element* is not transitive.	4. *Transitivity* - the relation of being a *component* is transitive. For example, if the dashboard is a component of the car, and the speedometer is a component of the dashboard, then the speedometer is also a component of the car.

From the perspective of the nature of a set, a *system* can be defined in three ways: solely as a collective set, solely as a distributive set, or alternatively, as both collective and distributive. *The first* approach precludes the use of set-theoretic apparatus, at least certainly when a researcher wishes to employ formal methods. *The second* significantly narrows the domain of objects that satisfy the systemic characteristic, while *the third* necessitates specifying the nature of the system under consideration each time.

In logical-mathematical considerations, sets are often used, where the elements are also sets. Sets conceived in this way are referred to as a *family of sets*. This concept can be successfully employed to solve the problem of defining the concept of a '*system*'. After all, nothing prevents us from using the attributive method of constructing a distributive set, i.e., by indicating a certain property as the criterion for isolating a set - treating any arbitrary system as a system in the set-theoretical sense. Of course, in relation to abstract systems of this kind, difficulties do not arise at all.

Let's consider, for example, a family of sets representing *car components*, where the elements are sets corresponding to individual parts such as wheels (set of wheels), engines (set of engines), dashboards (set of dashboards), and so on. With these assumptions, one can construct *a family of sets* that encompasses individual cars, specifying their component parts; each set in the family represents a particular car component. By appropriately transforming linguistic expressions (e.g., replacing '*car*' with '*set of car components*'), one can obtain a theoretical-systematic characterization of any objects, utilizing the concept of sets in a distributive sense.

Given the above findings, we establish the following general definition of a system:

> **<u>Def. 2.3.</u> *System* is a distributive set (family of sets) comprising arbitrary elements $E_1 \ldots E_n$, couplings between them $S_1 \ldots S_n$ (internal relations), input-output relations $W_1 \ldots W_n$ (external relations) between the elements of the system and elements of the environment. Formally: $S \Leftrightarrow (E_1 \ldots E_n, S_1 \ldots S_n, W_1 \ldots W_n)$.**

There are many different types of systems, and they can be categorized based on various criteria. For example: the number of elements (*small, large*); human involvement in system creation (*natural, artificial*); method of organization (*real, conceptual, abstract*); the relationship between the system and its environment (*open, closed, relatively isolated*); system variability over time (*static, dynamic*), and so forth.

The crucial matter in system theory is the exact distinction between a *system* and its *environment*, as defining boundaries simultaneously implies a substantive determination of the system in accordance with the adopted criterion. It should be emphasized that this differentiation remains somewhat arbitrary to some extent. From the historical perspective of system theory, at least two different ways of addressing this issue can be identified, associated with the names of L. von Bertalanffy and H. Greniewski.

1. According to the perspective of *Ludwig von Bertalanffy* (1901-1972) formulated within his biological theory of systems, there are only two types of systems, namely open systems and closed systems.

Open systems - occur when there is an exchange of energy and matter between the system and its environment.

Closed systems - are characterized by the exclusive exchange of energy between the system and its environment.

However, open and closed systems in Bertalanffy's understanding are not entirely open or closed but are equipped with certain permeable shields. Otherwise, the system as a distinct entity would disintegrate in a short time. For example, he lists the following characteristic features of a biological organism as an open system: exchange of components with the environment, self-regulation, maintaining a state of stability while being supplied with energy from the outside, and *equifinality*. The latter characteristic even defines a fundamental difference between open and closed systems:

> The first is the principle of equifinality. In any closed system, the final state is unequivocally determined by the initial conditions: (…) If either the initial conditions or the process is altered, the final state will also be changed. This is not so in open systems. Here, the same final state may be reached from different initial conditions and in different ways. This is what is called equifinality, and it has a significant meaning for the phenomena of biologica! regulation[27].

2. *Henryk Greniewski* (1903-1972) - a Polish cybernetician, consistently distinguishes between *absolutely* isolated systems and *relatively* isolated systems. Both can be characterized by two theses[28]:

Absolutely isolated system:

(a) remains unaffected by the rest of the Universe,

(b) exerts no influence on the rest of the Universe.

Relatively isolated system:

(a) the rest of the Universe acts on our system, but the interaction occurs only along specific, so to speak, "paths" called system inputs,

(b) our system influences the rest of the Universe, but this interaction takes place, so to speak, only through certain "paths," namely through the outputs of our system.

> We began our conceptual framework review with the concept of a relatively isolated system. The concept of such a system, along with the notions of input and output, are abstract entities that can be challenging to precisely define. They can be accurately specified by treating them as so-called primitive concepts and adopting a set of postulates regarding these concepts[29].

According to H. Greniewski, the concept of a relatively isolated system is not new at all; characteristics defining it can be found, for instance, in the typology of personalities proposed by Hippocrates in the 3rd century BCE (choleric, sanguine, phlegmatic, melancholic).

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[27] Ludwig von Bertalanffy (1968), *General System Theory*, George Braziller, New York, p. 40.

[28] Henryk Greniewski (1969), *Cybernetyka niematematyczna* (Nonmathematical cybernetics), PWN, Warszawa, p. 21.

[29] Rozpoczęliśmy nasz przegląd aparatury pojęciowej od pojęcia układu względnie odosobnionego. Pojęcie takiego układu, pojęcie wejścia i pojęcie wyjścia są to twory abstrakcyjne, dość trudne do sprecyzowania. Można je poprawnie sprecyzować, traktując *je* jako tzw. pojęcia pierwotne i przyjmując pewien zbiór postulatów dotyczących tych pojęć, Ibidem, p. 22.

In the context of axioeventism, it is accepted that *Relatively Isolated Systems* (RIS) constitute the only type of systems that can sensibly be discussed in the Ontic Universe. On the other hand, open or closed systems in the sense of Bertalanffy, as well as absolutely isolated systems in the sense of Greniewski, are considered to be idealized constructs, useful for certain purposes but not closely related to the actual state of affairs. This is because every event of any kind and every set of such events remains connected to others through specific relations. A Relatively Isolated System is defined as follows:

> **Def. 2.4.** ***Relatively Isolated System*** **(RIS) - is a system that, during informational, eventistic, axiocreative, and temporal interactions with the environment, maintains its global (essential and peripheral) structure in a precisely defined ontic situation.**

Every *Relatively Isolated System* (RIS) possesses a *global structure* composed of an *essential structure* (determining its essence, being, or nature), i.e., a set of features or relations constitutive for the given Relatively Isolated System, and an *accidental structure*, i.e., a set of features or consequential relations, derived from the constitutive ones:

> **Def. 2.5.** ***The Global Structure*** **of any Relatively Isolated System consists of two subordinate structures:** ***the Essential Structure*** **(essence, being, nature) – a set of features or relations constitutive for the given Relatively Isolated System, and** ***the Accidental Structure*** **– a set of features or consequential relations (derived from the constitutive ones) in the given Relatively Isolated System.**

The essential structure is relatively *static* in the sense that it undergoes changes to a limited extent, whereas the accidental structure exhibits a relatively high degree of *lability* - it easily undergoes changes as a result of ontic interactions of any kind.

2.2. Modelling of Relatively Isolated Systems – Axioeventistic Approach

Modelling is the process of representing certain fragments of the Ontic Universe, i.e., any objects (in particular, the Ontic Universe in a global sense, i.e., as a whole); the outcome of modelling is, of course, models. The modelling procedure involves reference to three elements of reality: *the object* - any fragment of the Ontic Universe (reality itself, amorphous, unshaped), *the system-object* (S-object) - a distinguished fragment of the Ontic Universe, and *the system-construct* (S-construct) - a model of the system-object (S-object).

We assume that the procedure of systemic modelling, i.e., constructing a model of the system-object (i.e., S-construct), proceeds in three stages:

1. Extracting the system-object (S-object) in the Ontic Universe by identifying a certain fragment in accordance with a specified *identification principle* (Id_{prcp}).

2. Creating the system-construct (S-construct) by interpreting the system-object (S-object) according to a certain *interpretative principle* (Int_{prcp}). Systemic modelling and its final outcome - the model, or S-construct, thus refer not directly to the amorphous fragment (object) in the Ontic Universe but to the identified system-object (S-object) within it.

3. Testification of the system-construct (S-construct) in the domain of modelled objects in the Ontic Universe.

The concept was graphically presented in Figure 2.1.

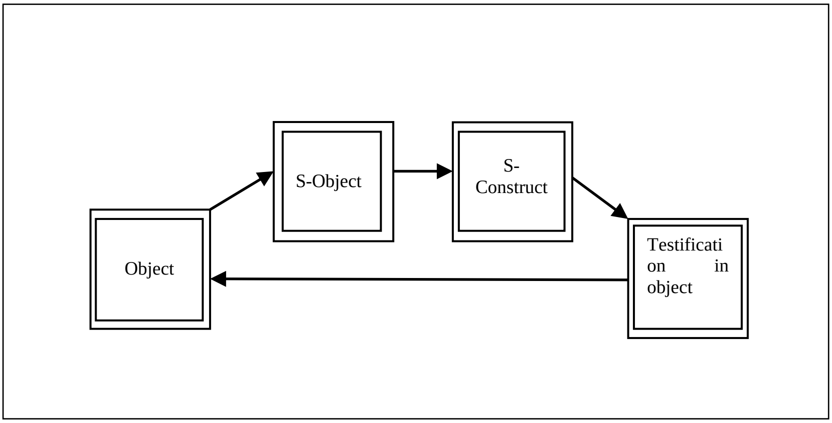

Figure 2.1. Sequence of stages in the systemic modelling procedure.

Therefore, it can be said that the subject of interest in systems theory is an *object*, any fragment of the *Ontic Universe*, reality itself, which takes shape during the systemic modelling procedure. This procedure - in accordance with the adopted principles - is based on a set-theoretic understanding. The S-object (system-object) and S-construct (system-construct) in every case constitute the result of idealization (abstraction) - the consideration by the modelling subject of certain object-events with their properties and relations between them, while neglecting others based on the adopted criteria. This idealization is determined by certain substantive criteria called, respectively, the principle of identification - Id_{prcp} (resulting in S-system) or the principle of interpretation - Int_{prcp} (generating S-constructs).

Thus, in the *ontological dimension*, a system denotes any *object*, concrete or abstract, composed of certain parts (elements) appropriately interconnected, i.e., an *S-object*. In the e*pistemological dimension*, however, this term is used to refer to a specific construct, i.e., an *S-construct*.

A system exclusively in the sense of an *S-object* is characterized by the following general properties:

1. The properties of the system as a whole influence the properties of its elements, and vice versa - the properties of the elements of the system affect the properties of the system as a whole.

2. The properties of the system as a whole differ from the properties of its individual elements; the system is something more than the sum of all its parts.

3. The system can simultaneously be an element of a higher-order system (supersystem) or a lower-order system (subsystem).

If t = 0 (time is not considered), we call a *Relatively Isolated System* (RIS) a *static system*; otherwise, it is referred to as a *dynamic system*. If the set X_1, ..., X_n contains only abstract objects (e.g., numbers, symbols, names, concepts), then RIS is termed an *abstract system*; otherwise, it is a *real system*. If the set X_1, ..., X_n contains only elements not created by humans, then RIS is a *natural system*, whereas elements created by humans form an *artificial system*.

According to Figure 2.1. there are three stages of systemic modelling within the framework of axioeventism (identification of the S-object, creation of the S-construct, and the testificatory procedure):

Identification of the S-object. Involves isolating, within a certain segment of reality (*object*), a set of elements that satisfy a predetermined relationship possessing a specified property. In this context, we refer to the *identification principle* (Id_{prcp}), indicating that the system is formed by a set of elements based on a given relation *R* with property *P*. Identification can be conscious or unconscious in nature (e.g., phototropism).

The identification of the S-object follows a specific identification principle (Id_{prcp}), which cannot be chosen arbitrarily and without limitations. The content of such a principle is closely determined by various factors, with the character of the knowing subject on one hand and the character of the Ontic Universe fragment (structural-static, structural-dynamic, or structural-result planes) being the subject of systemic modelling on the other.

> **Def. 2.6.** ***System-object* (S-object) - a system distinguished within any object by virtue of a specified *identification principle* ($\mathbf{Id_{prcp}}$) through defined eventistic interactions, i.e., interactions occurring between specific events in individual fragments of the Ontic Universe.**

Let's consider the following example. Let the object from the Ontic Universe be a *human being* understood as the Homo sapiens species, and let the relation *R* with property *P* (*identification principle:* $\mathrm{Id_{prcp}}$)) be alternatively: being a biological organism, being a social being, or being an organism motivated consciously to act. In this case, the *S-object* takes the form of, respectively: a set of individuals understood as biological organisms (studied by biology, natural anthropology, or medicine), a set of individuals in the sense of social collectives (studied by social and historical sciences), and finally, a set of individuals endowed with consciousness and engaging in actions in accordance with certain motivational factors (primarily studied by psychology).

The above example pertains to the Homo sapiens species, and as such, it takes into account the self-awareness of the object, which unequivocally directs the set of possible, meaningful identification principles. However, if we were to consider an animal and its cognitive situation, the scope of identification principles for the fragments of reality that the animal experiences would necessarily undergo a radical limitation (especially to the sphere of instincts).

Creation of the S-construct. Involves constructing a model, that is, mapping S-objects into S-constructs in accordance with the adopted *interpretative principle* ($\mathrm{Int_{prcp}}$). In contrast to the process of generating S-objects, the creation of the S-construct necessarily requires the existence of a conscious subject (particularly, a self-aware subject):

> **Def. 2.7.** ***System-construct* (S-construct) is a model of an S-object constructed by a given conscious subject based on a specified *interpretative principle* ($\mathbf{Int_{prcp}}$). The model constitutes a set of more or less justified theses.**

In general, the procedure unfolds in two stages (identification of S-objects and creation of S-constructs) as follows (Figure 2.2.).

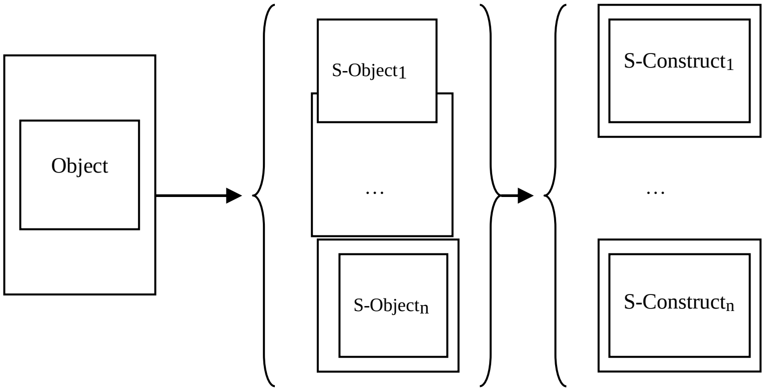

Figure 2.2. Procedure for the identification of S-objects and the creation of S-constructs.

In relation to an *object* within the Ontic Universe, there can be multiple realized *S-objects* in accordance with the identification principle (Id_{prcp}). Similarly, any number of *S-constructs* can be generated in relation to *S-objects*. However, it should be noted that not all of them must possess the same explanatory power. The creation of *S-constructs* is nothing more than the formulation of hypotheses, statements, and theories that explain or predict the existence or behaviours delineated from the Ontic Universe *S-objects*, following the interpretative principle (Int_{prcp}).

Consider the following example: If we take the *S-object* as a set of people acting according to certain motivational factors and further assume that motivational processes have a homeostatic nature, oscillating around the concept of relative equilibrium, certain *S-constructs* can be adopted as explanatory models for motivational processes. These models may, and often do, differ in their interpretations of S-objects. For instance, an interpretation might focus on analyzing multi-level adaptive responses (immune, neural, conscious) aimed at maintaining fundamental steady states, as well as solidifying one's identity. Alternatively, it might concentrate on the analysis of adaptation levels to stimuli ('background' or 'entrenched'), or on feedback loops, and so forth.

The testificatory procedure of an S-construct within an object involves assessing the adequacy (broadly understood) of delineating S-objects (Id_{prcp}) and creating S-constructs (Int_{prcp}) through appropriate testificatory procedures specific to the given type of S-objects and S-constructs. These procedures aim to verify or falsify the representations. They are depend on the type of scientific discipline that takes certain precisely defined fragments of the Ontic Universe as its subject.

2.3. Dynamics of Relatively Isolated Systems

Systemic modelling allows for the representation (extraction, creation) of objects in the Ontic Universe as *Relatively Isolated Systems* (RIS) in a static manner. However, an entirely different procedure enables the understanding of their dynamics, i.e., variability over time. The dynamics (temporal variability) of RIS are determined, depending on the type of RIS, by various determinations occurring both within the RIS and at the interface of the RIS with its environment. This may involve causal, functional, structural, or teleological determinations. *Determination* takes place either in relation to the elements of the system or in relation to the relationships (couplings) between them. Its essence lies in the *proliferation* (the process of rapidly spreading something) – increasing integration (disintegration) or decreasing integration (disintegration) within the *Essential Structure* of the *Relatively Isolated System* (RIS) in any plane: structural-static, structural-dynamic, structural-result (except for Reality of Abstract-Essential Structures - RAES) of the Ontic Universe and in any of its fragments.

The analysis of the dynamics of relatively isolated systems within the Ontic Universe, as understood in this way, is referred to as *proliferative analysis*. Essential proliferation can have a integrative or disintegrative character.

Integrative proliferation is characterized by the following features impacting the structure and functioning of the system:

1. Increasing the overall quantity (number) of connections between elements of the system or couplings among them.
2. Increasing the frequency of active connections between elements of the system.
3. Increasing the intensity (degree) of interactions between elements of the system.

<u>Def. 2.8.</u> *Integrative proliferation* - an increase, alternatively: in the number of elements, the number of connections between elements, or the intensity (strength, magnitude) of connections within a given Relatively Isolated System.

Disintegrative proliferation is characterized by features opposite to those of integrative proliferation:

1. Decreasing the overall quantity (number) of connections between elements of the system or couplings among them.
2. Reducing the frequency of active connections between elements of the system.
3. Decreasing the intensity (degree) of interactions between elements of the system.

> **<u>Def. 2.9.</u> *Disintegrative proliferation* - a decrease, alternatively: in the number of elements, the number of connections between elements, or the intensity (strength, magnitude) of connections within a given Relatively Isolated System.**

Disintegrative proliferation is characterized by features opposite to those of integrative proliferation:

1. Decreasing the overall quantity (number) of connections between elements of the system or couplings among them.
2. Reducing the frequency of active connections between elements of the system.
3. Decreasing the intensity (degree) of interactions between elements of the system.

Let's take the following example: The development of intelligence on Earth. In the early stages of life, single-celled organisms did not have the ability to react to their environment in an intelligent manner. In multicellular organisms, rudiments of the nervous system appeared, enabling responses to external stimuli. Further proliferation of neuronal connections shaped brains, allowing for the processing of incoming information (thinking). Over the subsequent millions of years, animals, through the evolution of brains, progressively developed their cognitive abilities and intelligent responses to environmental challenges. Finally, humans evolved from hominids, and in them, *integrative neuronal proliferation* radically altered the character of the brain. Humans possess a brain that enabled the development of language, along with the ability for abstract thinking, the creation of advanced technologies, and the progress of art, science, and philosophy.

The dynamics of *Relatively Isolated Systems* (RIS), constituted by essential proliferation, is influenced by various types of determinations, particularly: causal, functional, probabilistic, and teleological (teleomatic, programmatic, and purposive).

Causal Determination - determining the effect by its cause. It represents the most prevalent version of determinism in the history of philosophy. It signifies the doctrine that all events occurring in reality are subject to constant and unchanging regularities based on causal relationships. Thus, all events are considered as effects of earlier causes.

Causal determinism is based on two principles. The *first* is the principle of the universality of events - all objects in reality (conceptualized dynamically in the process of transformations) are interconnected.

The *second* is the principle of causality, which is generally attributed with the following characteristics:

1. Constancy of the causal connection - the occurrence of specific effects is conditional on the appearance of specific causes.
2. Priority of the cause over the effect.
3. Agency - the directional influence of one event on another; in the case of, for example, physical events, the interaction involves the spatial transfer of energy from a system with higher energy to a system with lower energy.

Functional Determination - mutual and symmetric interaction, meaning interaction without a distinguished direction. A good example of this can be gravitational or electromagnetic interaction; it is not the case that first the charge attracts positive, and then positive attracts negative.

Probabilistic determination (probabilistic determinism) – considering probabilities in the mutual interaction of *Relatively Isolated Systems* (RIS).

> **<u>Def. 2.10.</u> *Probabilistic determinism* signifies either each interaction of given Relatively Isolated Systems among themselves with specified probabilities or their interaction only with a certain probability, the latter increasing proportionally with the greater number of Relatively Isolated Systems participating in the interaction.**

Every interaction directly implies the probability of certain *Relatively Isolated Systems* or the so-called probability distribution (e.g., a Gaussian curve). An example of each interaction with a certain probability can be the classical case of *rolling a six* with a regular die (RIS_1 – the person rolling; RIS_2 – the result of the throw) or the *position of an elementary particle* in a spatial region (probability of its presence) as a result of measurement (RIS_1 – experimenter, RIS_2 – position of the elementary particle). On the other hand, examples of interactions with a certain probability can be found in *Pascal's law* in physics – the pressure of a gas on the vessel wall is uniformly distributed everywhere. If we consider a microscopic area of the vessel wall, fluctuations in the number of particle collisions may violate this law. However, on a large spatial and temporal scale, fluctuations average out, and thus Pascal's law is satisfied. Another example could be many of the so-called laws formulated in social sciences.

Teleological determination - interaction based on purpose. *Aristotle* listed four types of causes for motion: *formal* - the pattern, the plan of development over time for a specific thing or phenomenon; *material* - the substance from which something is made; *efficient* - everything that causes, as an internal or external factor, motion; and *final* - the end of development, the goal towards which something is directed. Only since the time of Galileo (1564-1642) have all causes basically been reduced to one - the efficient cause (*causa efficiens*).

Nowadays, especially in the field of biology, there are occasional attempts to utilize teleological language within the framework of the concept known as biological finalism. One of its proponents is the evolutionist *Ernst Mayr* (1904-2005). He believes that all objects or natural phenomena have the ability to change the state in which they currently exist. For example, gravity causes a stone thrown into a well to reach its goal or final state when it reaches the bottom. Similarly, a piece of iron heated to redness will achieve its goal or final state when its temperature equals that of the surroundings. In the world of living nature, behaviours directed towards a specific purpose are common (e.g., migration, obtaining food, or reproductive phases). E. Mayr refers to such processes as *teleomatic processes*:

> All objects of the physical world are endowed with the capacity to change their state, and these changes strictly obey natural laws. They are end-directed only in a passive, automatic way, regulated by external forces or conditions, that is by natural laws. I designated such processes as teleomatic to indicate that they are automatically achieved. All teleomatic processes come to an end when the potential is used up (as in the cooling of a heated piece of iron) or when the process is stopped by encountering an external impediment (as when a falling object hits the ground). The law of gravity and the second law of thermodynamics are

> among the natural laws which most frequently govern teleomatic processes[30].

Teleomatic processes are not equipped with any particular control program; they unfold entirely in accordance with the laws of nature.

Axioeventism recognizes teleological determination (purposefulness) as a fully equal component of Relatively Isolated Systems (RIS) determination. There are three types of teleological purposefulness distinguished: *teleomatic*, *programmatic*, and *intentional*.

Teleomatic purposefulness is directed towards a goal in a passive manner, regulated by external conditions. In connection with teleomatic processes in the sense of E. Mayr, both integrative and disintegrative essential proliferation can be passively directed towards a goal, determined on one hand by the quantity and intensity of proliferating elements, and on the other hand, by the environment of relatively isolated systems generating various ontic situations. In this case, proliferation comes to an end when the potential of a relatively isolated system is exhausted.

However, there are two fundamental differences between purposefulness in essential proliferation and teleomatic processes in the sense of E. Mayr: *first*, proliferation pertains to the entire Ontic Universe in the structural-static plane (including natural, psychic, social, and intelligible realities), not just natural reality as in E. Mayr's framework. The *second* difference concerns the location of the laws of nature; according to E. Mayr, teleomatic processes are subject to objective laws of nature, whereas in axioeventism, *essential proliferation* is precisely the process that determines the laws of nature, determining the behaviour or destruction of the *essential structure* of *Relatively Isolated Systems* (RIS).

Programmatic purposefulness involves the active realization of specific programs encoded within certain *Relative Isolated Systems*. In Aristotelian terminology, this is nothing more than the actualization of potential contained within a given being (a series of transformations embodying the essence of those beings). This type of purposefulness occurs to the same extent in the living natural world (e.g., the developmental sequence from egg to chicken, the body temperature regulation in mammals) as well as in social reality (e.g., educational processes enhancing the abilities of the learner, the implementation of social programs). It also manifests in various

[30] Ernst Mayr, *The Idea of Teleology* [in:] Journal of the History of Ideas, Vol. 53, No. 1 (Jan. - Mar., 1992), p. 125.

artificial artefacts programmed to perform specific tasks (e.g., thermostats, computer programs).

Intentional purposefulness simply means the setting of specific goals by an individual conscious entity (animal or human) or any social collectivities, with the intention of achieving them.

2.4. Situational essentialism

In general, essentialism is a philosophical position that posits observable phenomena as mere surfaces beneath which lies the true essence— a set of properties and relationships among component parts that constitute the object for what it is. Other properties and relationships are considered incidental, making them ontologically inferior to constitutive properties and relations. Simon Blackburn understands *essentialism* as follows:

> Essentialism. The doctrine that it is correct to distinguish between those properties of a thing, or kind of thing, that are essential to it, and those that are merely *accidental. Essential properties are ones that it cannot lose without ceasing to exist. Thus a person wearing a hat may take off the hat, or might not have been wearing the hat, but the same person cannot cease to occupy space, and we cannot postulate a possible situation in which the person is not occupying space. If we agree with this (it is not beyond debate, which illustrates the difficulty with essentialism), occupying space is an essential property of persons, but wearing a hat an accidental one. The main problem is to locate the grounds for this intuitive distinction. One suggestion is that it arises simply from the ways of describing things, and is therefore linguistic Or even *conventional in origin. Contrasted with this (the nominal essence) is the *Lockean idea that things themselves have underlying natures (real essences) that underly and explain their other properties[31].

The contemporary turn away from essentialism and the abandonment of grand, universal systems and holistic models have led to the flourishing of various discourses determined by cultural contexts, ideological-political conditions, and ethical considerations. It has been acknowledged that the world of human knowledge is a realm of permanent conflicts, where various partial discourses

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[31] Simon Blackburn, *The Oxford Dictionary of Philosophy* (1996), Oxford University Press, pp. 125-126.

collide. According to, for example, M. Foucault (1926-1984), unified general theoretical principles have been replaced by 'excavations'—non-uniform and variable fragments entangled in various contexts that determine their meanings.

Now, let's define the concept of an ontic situation in relation to the essence of any objects (Relative Isolated Systems), that is, an *ontic essentialist situation*. We will identify it with a *Relative Isolated System* that has certain limitations imposed on its interaction with the environment. These limitations are referred to as *boundary conditions*. Under these assumptions, the definition of an ontic essentialist situation takes the following form:

> **Def. 2.11. *Ontic Essentialist Situation* (OES) is a Relative Isolated System with a specified set of *Boundary Conditions*, i.e., conditions that must be met for a given element to belong unequivocally (or at least with a high probability) to a particular class of Relative Isolated Systems.**

Philosophical essentialism constituted by *ontic essentialist situations* is termed *situational essentialism* within axioeventism.

> **Def. 2.12. *Situational essentialism* is a philosophical position (adopted by axioeventism) that acknowledges the existence of a set of necessary, fixed, and immutable characteristics determining the essence of any Relative Isolated Systems, constituted by Ontic Essentialist Situations (OES).**

It should be emphasized that this understanding of *situational essentialism* applies exclusively to the natural, psychic, and social reality. It should be clearly distinguished from *absolute essentialism*, exclusively defined within the domain of *Reality of Abstract-Essentials Structures* (RAES).

The way of isolating *ontic essential situations* is unequivocally dictated, on the one hand, by the nature of specific fragments of the *Ontic Universe* (belonging to structural, dynamic, or result planes, excluding abstract-essential reality) and imposed *Boundary Conditions*. On the other hand, it is determined by *identification principles* (Id_{prcp}) and *interpretative principles* (Int_{prcp}), specifying certain S-Objects and S-Constructs in the given fragments of the Ontic Universe.

Let's take the following example:

Ontic Essentialist Situation (OES) consists of individuals who fulfill the personality types according to the Hippocratic typology.

Boundary Conditions - types designated by Hippocrates: sanguine - predominance of blood; choleric - predominance of yellow bile; melancholic - predominance of black bile; phlegmatic - predominance of phlegm.

S-object - species Homo sapiens.

S-construct - characteristics of individual human types: sanguine - a person positively disposed to the world and others; choleric - a domineering and uncompromising person; melancholic - a sensitive and empathetic person; phlegmatic - a slow but amiable person.

Under the above conditions, *situational essentialism* pertains exclusively to such a characterization of people (*S-construct*) that falls within the boundaries set by Hippocrates (*Boundary Conditions*). Different boundaries set in another way would determine a distinct constitutive characterization for situational essentialism.

3. STRUCTURAL-STATIC PLANE

3.1. Natural Reality

3.1.1. Relativity Theory

Geometric Foundations of the Theory of Relativity

In the theory of relativity, Einstein utilized solutions proposed by non-Euclidean geometries that arose from an alternative formulation of Euclid's fifth postulate. And here are the five postulates of Euclid:

1. *Straight Line Postulate*: A straight line segment can be drawn joining any two points.

2. *Endpoint Postulate*: Any straight line segment can be extended indefinitely in a straight line.

3. *Circle Postulate*: Given any straight line segment, a circle can be drawn having the segment as radius and one endpoint as center.

4. *Right Angle Postulate*: All right angles are congruent.

5. *Parallel Postulate*: If two lines are drawn which intersect a third in such a way that the sum of the inner angles on one side is less than two right angles, then the two lines inevitably

The illustration[32] of the Fifth Postulate of Euclidean Geometry is presented in Figure 3.1.

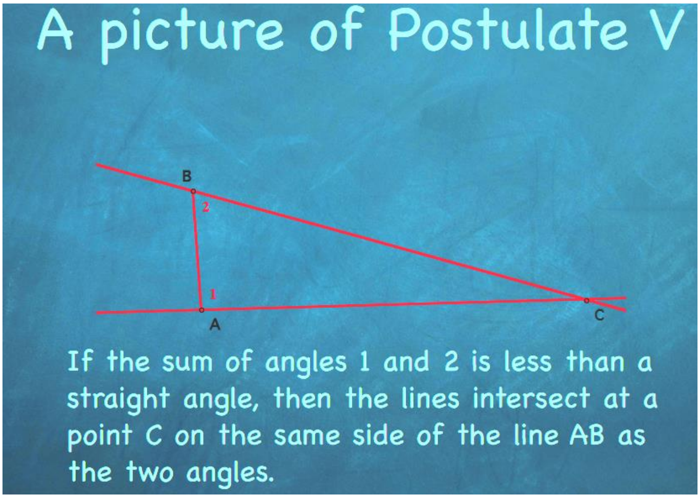

Figure 3.1.

[32] https://sites.math.washington.edu/~king/coursedir/m445w05/notes/non-euclidean.pdf

The fifth postulate, also known as the parallel postulate (or Euclidean axiom), has multiple formulations. In a fairly common formulation by J. Playfair (1748-1819), it reads as follows: *if a is any straight line and A is a point not on a, then in the plane determined by a and A, there exists at most one straight line passing through A and not intersecting a.* Two consequences of the parallel postulate are: *first,* the sum of angles in a triangle is 180 degrees, and *second*, a circle can be circumscribed around a triangle.

In the 18th century the Italia monk Giovanni Girolamo Saccheri (1677-1733), suggested that for a line and a point, there are three possibilities: 1) there is exactly one line through the point parallel to the given line; 2) there is no line trough the point parallel to the given line; 3) there is more than one line through the point parallel to the given line.

In the nineteenth, century Nicholas Lobachevsky (1793-1856) and Janos Bolyai (1802-1860), each worked independently, reached the same conclusions. The changed the 5th postulate to read: through a point not on a given line there passes more than one line parallel to the given line. This is usually called *hyperbolic geometry*. This is because, in this model, the surface takes the form of a 'saddle.' In hyperbolic geometry: 1) the length of a straight line is infinite; 2) the sum of angles in a triangle is less than 180 degrees; 3) the curvature is negative.

Another non-Euclidean geometry, called elliptic geometry, was created by Bernhard Riemann (1826-1866). He modified Euclid's fifth axiom as follows: through a point that does not lie on a given straight line, no straight line parallel to the given line passes. In elliptic geometry: 1) the length of a straight line is finite; 2) the sum of angles in a triangle is greater than 180 degrees; 3) the curvature is positive. The surface of a sphere serves as a two-dimensional model of Riemannian space.

In the 1850s, B. Riemann generalized the field of differential geometry to multiple dimensions. This branch of geometry examines curves, surfaces, and hypersurfaces, which are sets of points with local properties akin to Euclidean space, specifically spaces of dimension n-1.

The *first generalization* by Riemann involved moving from the plane (2 dimensions) and space (3 dimensions) to n-dimensional spaces with any number of dimensions. In other words, he generalized the concept of curvature to *n* dimensions. Initially, curvature was defined on a plane, but this generalization allowed for the consideration of curvature in higher dimensions, not only in

Euclidean space but also in higher dimensions - in *n-dimensional* space.

The determination of the square of the distance (metric) looks as follows:

p_1 – straight
p_2 – 2-dimensional space: $ds^2 = dx^2 + dy^2$
p_3 – 3-dimensional space: $ds^2 = dx^2 + dy^2 + dz^2$
…
p_n = n-dimensional space: $ds^2 = dx_1^2 + dx_2^2 + \ldots + dx_m^n$.

The *second generalization* by Riemann involved moving from flat, i.e., zero curvature space, n-dimensional (only one is flat), to infinitely many spaces with *elliptic* (concave) and *hyperbolic* (convex) curvature. Elliptic, hyperbolic, and Euclidean spaces are special cases of Riemannian geometry. If each of these spaces has the same curvature at every point, they are called spaces of constant curvature (e.g., the surface of an ordinary sphere). The concept of space can be further generalized by allowing curvature to change from point to point, being sometimes less or more concave or convex, possessing elliptic or hyperbolic points. The quantity uniquely characterizing the curvature of space at a given point is called the curvature tensor (tensor - a mathematical object that is a generalization of the concept of a vector):

Scalar: $T_0^1 = x$ - tensor of zero order (p_1 space).
Vector: $T_1^2 = (x,y,z)$ - first order tensor (p_2 space).

Tensor: $T_2^3 (T_x, T_y, T_z) = \begin{pmatrix} Txx & Txy & Txz \\ Tyx & Tyy & Tyz \\ Tzx & Yzy & Tzz \end{pmatrix}$ - second-order tensor

in three-dimensional space (p_3 space).

Tensor: $T_2^4 (T_x, T_y, T_z, T_i) = \begin{pmatrix} Txx & Txy & Txz & Txi \\ Tyx & Tyy & Tyz & Tyi \\ Tzx & Tzy & Tzz & Tzi \\ Tix & Tiy & Tiz & Tii \end{pmatrix}$ - second-order

tensor in four-dimensional space (p_4 space).

In the *Special Theory of Relativity* (STR), a specific case of Riemannian geometry developed by Minkowski in 1908 was used, and thus STR geometry is known as Minkowski geometry (zero curvature). In this geometry, time and space are treated as coordinates in a four-dimensional space, referred to as spacetime. This means that every event in this space is described by four coordinates: three spatial (x, y, z) and one temporal (t). The Minkowski metric applies, which is a function describing distances between points in spacetime:

$$ds^2 = -c^2dt^2 + dx^2 + dy^2 + dz^2,$$

where:
c is the speed of light,
t is time,
(d*x, dy, dz*) are the spatial coordinate differences: *x, y, z*.

The sign in front of the time coordinate is negative, indicating that time is treated differently than space. Minkowski geometry is a mathematical formalism used to describe spacetime in the framework of the special theory of relativity. It has a non-Euclidean character; time and space are related in a way dependent on the velocity of objects and specific phenomena in STR, such as time dilation and length contraction.

In the *general theory of relativity* (GTR), Riemannian geometry is used. In particular, a second-order tensor in four-dimensional space (*Riemann tensor*) is used: T_2^4 (T_x, T_y, T_z, T_t), where the fourth dimension is time. Unlike spacetime analyzed in STR, here spacetime undergoes curvature due to mass and energy (gravity). The dynamics of spacetime are described by Einstein's field equations, which describe the relationship between the distribution of mass and energy and the curvature of spacetime. The *Riemann tensor* describes the curvature of spacetime at any point, and the *Einstein metric tensor* (defined, among other things, based on the Riemann tensor), which is part of the gravitational equations, describes the influence of mass and energy on the curvature of spacetime. Therefore, in Riemannian geometry, spacetime is curved, which means that curvature is not limited to a value of zero, as is the case in Minkowski geometry.

However, one can say that spacetime analyzed in STR and GTR is the same space, but it is described differently in the context of these two theories. In STR, it is described using Minkowski geometry (non-Euclidean space with zero curvature) in the context of reference frames moving uniformly relative to each other at a constant velocity, without considering gravity. While spacetime analyzed in GTR is described using Riemannian geometry in the context of its curvature caused by the presence of mass and matter (gravity).

Mechanistic Theory versus Field Theory. In the physics of the late 19th century, there was a collision of two worldviews. One of them is the mechanistic view, closely associated with the name of Isaac Newton (1643-1727), and the other is the field view, championed by James Clerk Maxwell (1831-1879). According to the *mechanistic theory*, fundamental concepts describing physical reality include: *point masses*, *forces*, *absolute space* encompassing all physically existing objects (but independent of them), and absolute time flowing uniformly for all objects in the universe. On the other hand, the *field theory* operates with only three fundamental concepts: *fields*, *space*, and *time*. Its characteristic feature is the description of changes occurring continuously in space and time. Furthermore, differences between these two theories are evident at the mathematical level. The equations of classical mechanics are ordinary differential equations, while field equations are partial differential equations.

In the mechanistic theory, a system of material objects relative to which a particular physical phenomenon is described is referred to as a *reference frame*. For the sake of the convenience of observations and the effective discovery of the laws governing the phenomenon, a reference frame is chosen in scientific practice that exhibits the greatest simplicity. In classical mechanics, the class of reference frames that allows the simplest description of phenomena is known as *inertial frames*; these are simply frames distinguished by Newton's principle of inertia. It is assumed that there is an infinite number of equivalent inertial frames.

In the 17th century, the Italian scholar Galileo Galilei (1564-1642) proposed a mathematical description known as *Galilean transformation*, which explains how certain physical quantities (e.g., *position* and *time*) change when transitioning from one frame (associated with an observer on Earth) to another frame (associated with the motion of an object). For example, for one-dimensional motion of a uniform system (without acceleration), the Galilean transformation takes the following form:

$$x' = x - vt \quad y' = y \quad z' = z \quad t' = t,$$

where:

(x, y, z, t) are the coordinates (position and time) in one reference frame (associated with an observer on Earth).

(x', y', z', t') are the coordinates in the other reference frame (associated with the motion of the object).

v is the velocity relative to the observer in the first frame.

The Galilean transformation assumes that *time is absolute*, meaning it is the same in both reference frames, regardless of the motion of objects. This approach works well in everyday situations when the velocities of objects are significantly smaller than the speed of light.

The fundamental principle of the mechanistic theory is the *classical principle of relativity* (Galilean-Newtonian principle), which states that the laws of classical mechanics have the same form in every inertial reference frame (the laws of mechanics are invariant under Galilean transformations). In other words, the laws of physics are the same in all reference frames moving at constant relative velocities. This means that one cannot unambiguously distinguish whether they are at rest in a given reference frame or moving at a constant speed relative to another frame. It should be noted that the *classical principle of relativity* was an assumption existing before the formulation of *Galilean transformations.* This transformation serves only as a mathematical tool for describing changes in physical quantities when transitioning from one reference frame to another. In this sense, it is a concretization of the classical principle of relativity.

The achievements of the mechanistic theory in the 19th century gave rise to the belief that the classical principle of relativity should apply without exception to all physical laws. However, this was not the case. The theory of the electromagnetic field (*classical electrodynamics*), developed by Maxwell in 1865, turned out to be inconsistent with this principle. Based on mathematical analysis, Maxwell predicted the existence of electromagnetic waves with properties entirely consistent with those of light. This was evidence that visible light possesses the nature of electromagnetic waves. Under the influence of this discovery, physicists' belief in the existence of Newton's absolute space, an immovable and infinite container existing independently of whether or not anything is in it, was shaken. Light is a wave, so there must be a medium filling all of space, the vibrations of which are precisely electromagnetic waves. This medium was called the '*ether*'. In this situation, the answer to the question of what light is did not pose difficulties - light is waves of the ether.

The Concept of Ether. The hypothesis of the existence of the ether was known in ancient times. At that time, it was believed that ether was a substance permeating the entire celestial system, in which heavenly bodies were supposed to move. Throughout the history of philosophy, this hypothesis underwent various developments, and its resurgence occurred at the end of the 19th century.

If we assume that the Earth is moving relative to an absolutely stationary ether, then we could measure the speed of light between two points on the Earth's surface and compare the result with the measurement of the speed of light traveling in the opposite direction. If the ether hypothesis were correct, we would observe a change in the speed of light propagation depending on the Earth's rotation. The speed of light should be slightly lower in the direction of the Earth's motion than in the opposite direction. This predicted result was called the 'ether wind effect'. However, experimental confirmation of this effect posed significant technical challenges due to the relatively large difference between the speed of light and the Earth's motion. The precision level required to conduct a decisive experiment (*experimentum crucis*) was achieved at the end of the 19th century.

In 1887, two physicists and experimenters, *Albert A. Michelson* (1852-1931) and *Edward W. Morley* (1838-1923), conducted their famous experiment using the Michelson *interferometer*. The result was negative: no difference in the speed of light propagation was observed; it remained the same regardless of the observer's motion. Physicists attempted to explain the experiment's results in various ways, trying to salvage the concept of ether. One approach was to introduce an additional hypothesis that the speed of light may depend on the motion of the light source, or that the ether near Earth participates in Earth's motion. However, the *concept of H. Lorentz* turned out to be the closest to reality. Based on his electron theory, which was an extension of Maxwell's electromagnetic field theory, he put forth two hypotheses.

The *first one* is that every moving body contracts in the direction of its motion. In his electron theory, Lorentz considered matter as a system of charged particles in motion. In regions near which these particles passed, the electromagnetic field changed over time. Lorentz showed that in a changing field, surfaces of constant potential were no longer spheres but became flattened in the direction parallel to the motion of the particles. In other words, electrons changed their mutual distances, and as a result, a material object decreased in size in the direction of its motion (Lorentz contraction).

The *second hypothesis* is that the rate of time flow changes in every system in motion. Lorentz formulated field equations that involved the auxiliary concept of local time. As a consequence, there was a hypothesis about the slowing of time flow in systems moving at sufficiently high speeds, caused by the interaction of electrons and the ether (*Lorentz time dilation*).

Postulates of Einstein's special theory of relativity (SPR): constancy of the speed of light and the special (generalized) principle of relativity (rejection of the concept of ether):

> The difficulty that had to be resolved amounted to choosing amongst three alternatives:
> 1. The Galilean transformation was correct and something was wrong with Maxwell's equations.
> 2. The Galilean transformation applied to Newtonian mechanics only.
> 3. The Galilean transformation, and the Newtonian principle of relativity based on this transformation were wrong and that there existed a new relativity principle valid for both mechanics and electromagnetism that was not based on the Galilean transformation.
> The first possibility was thrown out as Maxwell's equations proved to be totally successful in application. The second was unacceptable as it seemed something as fundamental as the transformation between inertial frames could not be restricted to but one set of natural phenomena i.e. it seemed preferable to believe that physics was a unified subject. The third was all that was left, so Einstein set about trying to uncover a new principle of relativity. His investigations led him to make two postulates:
> 1. All the laws of physics are the same in every inertial frame of reference. This postulate implies that there is no experiment whether based on the laws of mechanics or the laws of electromagnetism from which it is possible to determine whether or not a frame of reference is in a state of uniform motion.
> 2. The speed of light is independent of the motion of its source[33].

[33] James D. Cresser (2003), *The Special Theory of Relativity*, Macquarie University, Sydney, p. 14.

Constancy of the Speed of Light. The speed of light in a vacuum is the same in all inertial reference frames, meaning it is independent of the direction of light propagation and the motion of the reference frame.

In classical physics, time was an absolute concept, independent of the physical phenomena it referred to. Therefore, it was not surprising that a specific class of events could occur at different locations simultaneously, meaning at the same moment in time. The multitude of events in the universe could be located along a common axis of universal time. However, to make meaningful measurements, one must possess clocks that have the same rhythm and indicate the same time. In other words, the clocks must be synchronized. Einstein challenged the possibility of finding a reliable method in classical physics that would allow clock synchronization and thereby determine whether two arbitrarily separated events are simultaneous or not. The postulated simultaneity of events can never be confirmed. Furthermore, the issue of simultaneity becomes extremely complicated when dealing with time measurements in moving reference frames. Calculations reveal that the time interval read on a clock moving with a given reference frame is always smaller than the time interval that has passed on a stationary clock.

To give physical meaning to the concept of *simultaneous events separated in space*, Einstein introduced the following hypothesis: the speed of light (broadly, electromagnetic waves) is always the same, regardless of the observer's motion or the motion of the light source. This hypothesis allows the synchronization of clocks. At first glance, it may seem paradoxical because, in every case, regardless of the magnitude of the component velocities, their algebraic sum never exceeds the limiting velocity, i.e., the speed of light. The apparent paradox arises from the fact that our common-sense thinking has been shaped, first, by observing speeds that are incomparably smaller than the speed of light and, second, by intuitive notions of space and time that do not withstand the test of rigorous, abstract research. Thus, the fundamental assumption of the Special Theory of Relativity (STR) states the absolute nature of the speed of light (electromagnetic waves) in a vacuum. This assumption was not adopted a priori but represents an unassailable acceptance of the result of the *Michelson-Morley experiment.* Abstract analysis of the concept of simultaneity merely confirmed the verdict of the experiment.

Special Principle of Relativity (Generalized): It states that all the laws of physics have the same form in all reference frames moving at constant, uniform velocities relative to each other. Physical laws such as Newton's laws of motion and Maxwell's laws of electrodynamics apply in the same way in all reference frames. In other words, in every reference frame (inertial, where there are no forces that would accelerate or decelerate it), all the laws of physics are the same. Einstein's Special Principle of Relativity is one of the cornerstones of his theory of relativity and contradicts the traditional conception of absolute time and space. It posits that there is no absolute reference frame, and all reference frames are equivalent.

While the *classical principle of relativity* was the basis for *Galilean transformations*, the *special principle of relativity* is the basis for *Lorentz transformations*. Therefore, according to the special principle of relativity, all the laws of physics are invariant (unchanged) under Lorentz transformations.

Lorentz transformation is a mathematical transformation used in Einstein's theory of relativity to describe changes in position and time between two reference frames moving at a constant velocity close to the speed of light relative to each other. Unlike Galilean transformations, which are an approximate description of the motion of frames moving at low speeds, Lorentz transformations account for *relativistic effects* that occur under extreme conditions, such as velocities close to the speed of light. Hendrik A. Lorentz introduced the Lorentz transformation in the late 19th century, and it was later developed in Einstein's theory of relativity. The equations for Lorentz transformations are as follows:

> In the meantime, H. A . Lorentz noticed a remarkable and curious thing when he made the following substitutions in the Maxwell equations:
>
> $$\begin{aligned} x' &= \frac{x - ut}{\sqrt{1 - u^2/c^2}}, \\ y' &= y, \\ z' &= z, \\ t' &= \frac{t - ux/c^2}{\sqrt{1 - u^2/c^2}}, \end{aligned} \qquad (15.3)$$
>
> Maxwell’s equations remain in the same form when this transformation is applied to them! Equations (15.3) are known as a Lorentz transformation. Einstein, following a suggestion originally made by Poincaré, then proposed that *all the physical laws should be of such a kind that they*

remain unchanged under a Lorentz transformation. In other words, we should change, not the laws of electrodynamics, but the laws of mechanics[34].

In the above equations:
(x, y, z, t) are coordinates in one reference frame,
(x', y', z', t') are coordinates in another reference frame,
v is the velocity of one reference frame relative to the other,
c is the speed of light in a vacuum.

Unlike Galilean transformations, where the spatial distance between events and the time interval between them remain unchanged, in *Lorentz transformations*, it's different: the distances between events and time intervals, as measured by observers moving relative to each other, depend on the velocities of the frames they are in.

Relativistic effects of Einstein's Special Theory of Relativity (STR) include the following: time dilation, length contraction, increasing mass, and the equivalence of mass and energy.

Time dilation. It is described by the following formula (derived from the Lorentz transformation):

$$\Delta t' = \frac{\Delta t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

where:
$\Delta t'$ - the time observed in a frame of reference moving at velocity v.
Δt - time observed in the stationary reference frame.
v - the velocity of an object moving relative to the observer in the stationary frame.
c - the speed of light in a vacuum.

This formula expresses the fact that time in a frame of reference moving at speed v is stretched compared to time in the stationary frame. The greater the velocity v relative to the speed of light c, the greater the time dilation, which means that time passes more slowly in the moving frame, the higher its velocity.

Length contraction. The formula for length contraction derived from the Lorentz transformation in Einstein's Special Theory of Relativity is as follows:

[34] Richard P. Feynman, Robert B. Leighton, Matthew Sands (2010), *The Feynman Lectures on Physics*, Vol I, Published by Basic Books, 15-2.

$$L' = \frac{L}{\sqrt{1 - \frac{v^2}{c^2}}}$$

where:
L' - the length of an object observed in a frame of reference moving at velocity v.
L - the length of the object observed in the stationary reference frame,
v - the velocity of an object moving relative to the observer in the stationary frame,
c - the speed of light in a vacuum.

This formula expresses how much an object's length is contracted in the direction of motion in a frame moving at velocity *v* compared to its length in the stationary reference frame. The greater the velocity *v* relative to the speed of light *c*, the greater the length contraction.

Increasing mass. The formula for increasing mass is as follows:

$$m' = \frac{m}{\sqrt{1 - \frac{v^2}{c^2}}}$$

where:
m' – the observed mass of an object in a reference frame moving with velocity v,
m - the mass of the object observed in the stationary reference frame.
v - the velocity of an object moving relative to the observer in the stationary frame.
c - the speed of light in a vacuum.

This formula expresses how much an object's mass increases in a frame moving at velocity *v* compared to its mass in the stationary reference frame. The greater the velocity v relative to the speed of light c, the greater the increase in mass. This effect means that the faster an object moves, the more energy is required to further accelerate it. This result is significant in particle physics (particle accelerators).

Equivalence of mass and energy[35]. Einstein formulated the equation:

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[35] *The principle of equivalence of mass and energy* describes how mass and energy are interrelated in a relativistic context. On the other hand, the principle of conservation of mass and energy speaks to the preservation of mass and energy in a closed system, regardless of transformations between them. In other words, in an isolated closed system, mass and

$$E = mc^2$$

where:
E - energy,
m - mass,
c - the speed of light in a vacuum.

This equation means that the mass of any physical object and its energy are closely interconnected, in the sense that mass can transform into energy and *vice versa*; mass is a form of energy, and *vice versa*. When a physical object moves at high speeds, its mass increases (proportional to the speed), and its kinetic energy also increases. This equation explains the difficulties associated with reaching speeds close to the speed of light in a vacuum. The higher the velocity, the greater the mass increase, and the more energy is required to accelerate the object further. On the other hand, energy can be converted into mass in processes such as nuclear reactions or transformations of elementary particles.

In *nuclear reactions*, such as nuclear fusion occurring in stars or the decay of atomic nuclei in nuclear reactors, energy is released or absorbed. These reactions lead to a change in the mass of atomic nuclei. The equation $E = mc^2$ explains that this energy is equivalent to the change in mass during the process. For example, in the process of nuclear fusion in the Sun, energy is generated by the fusion of light nuclei into a heavier helium nucleus, and this energy is equivalent to the mass deficit in the process.

In experiments at very high energies, such as those conducted in *particle accelerators*, new elementary particles can be created or existing particles can decay. The equation $E = mc^2$ explains that the kinetic energy of particles in these processes is equivalent to the mass of those particles. For example, in particle accelerators, processes can be observed where kinetic energy is transformed into new elementary particles.

Subatomic particles, such as quarks and gluons, which make up protons and neutrons, have their masses shaped by *strong interactions.* These interactions are the result of converting energy into mass according to the equation $E = mc^2$.

General Theory of Relativity

Albert Einstein's General Theory of Relativity (GTR) emerged from theoretical considerations and attempts to resolve certain

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energy (of various kinds) cannot be either lost or created, only transformed into different forms.

problems and contradictions in theoretical physics during the pivotal period at the turn of the 19th and 20th centuries. There were specific theoretical and experimental situations that contributed to the development of GTR. Classical (Newtonian) physics was well-established and effective in describing the motion of bodies in our everyday experience. However, issues began to arise in Newtonian physics, which couldn't explain many physical phenomena, including the problem of the perihelion of Mercury (the closest point in Mercury's orbit around the Sun), which couldn't be definitively explained even when accounting for the influence of other planets. Another challenge was the bending of light in a gravitational field. All these theoretical situations inspired Einstein to develop the General Theory of Relativity (GTR), in which he introduced the revolutionary concept of the curvature of spacetime caused by mass and energy, thereby initiating an entirely new way of thinking about gravity.

Einstein attempted to explain these puzzling physical phenomena through theoretical considerations and by employing what are known as '*thought experiments'*. He was particularly interested in understanding the difference, if any, between acceleration and gravity. In solving this problem, Einstein found valuable insight from a *thought experiment involving an elevator*. He considered a situation in which we are in a closed elevator with no access to external sources of information. In this scenario, according to Einstein, there is no way to determine whether we are being pulled towards the Earth by gravity or if the elevator is accelerating in outer space. Therefore, there are two possibilities: the elevator could either be at rest in a gravitational field or moving upward with constant acceleration. Einstein concluded that both cases would result in the same experiences. This led him to the conclusion that gravity and acceleration are equivalent.

In this context, it is worth mentioning the '*experiment of von Eötvös'*, which, as early as the 19th century, demonstrated that gravity affects all objects in the same way, regardless of their mass or composition:

> Lorand von Eötvös**,** Budapest, 1899 and 1922: compared on the rotating earth the vertical defined by a plumb bob of one material with the vertical defined by a plumb bob of either material. The two hanging masses, by the two unbroken threads that support them, were drawn along identical world lines through spacetime (middle of the laboratory of Eötvös!). If cut free, would they also follow identical tracks

> through spacetime ("normal world line of test mass")? If so, the acceleration that draws the actual world line from the normal free-fall world line will have a standard value, a. The experiment of Eötvös did not try to test agreement on the magnitude of a between the two masses[36].

The Eötvös Experiment, also known as the Equivalence Experiment, was a crucial experiment conducted in the 19th century aimed at confirming the equivalence of gravity and acceleration within classical physics. Specifically, it sought to understand the difference between the masses of various materials and their impact on gravitational force. The experiment was named after the Hungarian physicist Loránd Eötvös, who, along with his team, conducted a series of precise measurements in Hungary from 1889 to 1900.

The idea behind the Eötvös Experiment was as follows: if gravity is equivalent to acceleration, then all objects of different masses should fall under gravitational acceleration with the same rate. However, if gravitational acceleration differs from inertial acceleration (e.g., acceleration caused by the observer's motion), then objects of varying masses should fall with different acceleration rates. Eötvös decided to conduct the experiment to examine whether objects of different masses fall with different acceleration rates. The experiment's ultimate conclusion was that it did not reveal significant differences in the accelerations of falling bodies based on their mass and composition. In other words, the Eötvös Experiment confirmed the equivalence of gravity and acceleration within the precision limits of the measurements of that time.

Postulates of the General Theory of Relativity (GTR). In Einstein's General Theory of Relativity three fundamental postulates can be identified that capture its essence: the general principle of relativity, the principle of the equivalence of gravity and acceleration, and the principle of the curvature of spacetime under the influence of the mass and energy of physical objects.

General Principle of Relativity. In contrast to the Special Principle of Relativity (SPR), which states that the laws of physics are the same in all inertial reference frames moving at a constant velocity (without acceleration), the General Principle of Relativity asserts that the laws of physics are the same in all reference frames, regardless of

[36] Charles W. Misner, Kip S. Thorne, John Archibald Wheeler (1973), *Gravitation*, W.H. Freeman and Company, p. 16.

their type of motion, and whether they are subject to acceleration or not. There is no ‘privileged’ reference frame that serves as an absolute point of reference for other frames. Thus, the General Theory of Relativity can be regarded as a theory that generalizes the Special Theory of Relativity by treating all reference frames (e.g., an observer on Earth and one in space) as equivalent. This means that any reference frame can be used for describing and predicting physical phenomena, although not all may be equally convenient.

Equivalence Principle. This principle states that gravitational force and unit acceleration (e.g., the acceleration of any vehicle, such as an elevator or a rocket) are indistinguishable[37]. The gravitational force acting on any physical object is equal to the force of acceleration acting on any physical object that is not subject to gravitational interaction.

> Why is this feature of gravity called ‘the principle of equivalence’? The ‘equivalence’ refers to the fact that a uniform gravitational Weld is equivalent to an acceleration. The effect is a very familiar one in air travel, where it is possible to get a completely wrong idea of where ‘down’ is from inside an aeroplane that is performing an accelerated motion (which might just be a change of its direction). The effects of acceleration and of the Earth’s gravitational field cannot be distinguished simply by how it ‘feels’ inside the plane, and the two effects can add up in two different directions to provide you with some feeling of where down ‘ought to be’ which (perhaps to your surprise upon looking out of the window) may be distinctly different from the actual downward direction[38].

As a result, no local physical experiments are capable of distinguishing between the effects of gravity and acceleration. If an observer is within a closed vehicle and experiences a force, they have no means of determining whether it is due to gravity or acceleration. In other words, a person inside a sealed chamber cannot distinguish between being in a state of rest within a uniform gravitational field or accelerating with constant acceleration in a gravity-free space.

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[37] Sometimes, there is mention of the so-called ‘*weak equivalence principle*’ which states that at any point in spacetime, one can choose a reference frame in which the laws of physics are the same as in a frame devoid of gravity. In other words, gravitational effects can be neutralized by choosing an appropriate inertial frame.

[38] Roger Penrose (2004), *The Road to Reality A Complete Guide to the Laws of the Universe*, Jonatham Cape London, p. 392.

The Principle of Curvature of Spacetime Due to the Mass and Energy of Physical Objects. The General Principle of Relativity led Einstein to the conviction that if all the laws of physics are the same in all reference frames, this must also apply to the laws of physics in the presence of gravity. This prompted him to search for a theory of gravity that would be consistent with this principle.

Einstein proposed that physical objects with mass or energy (remember, $E = mc^2$) curve the spacetime around them. In the context of the Special Theory of Relativity, spacetime was considered flat because it did not account for gravity. According to this perspective, gravity is not a force of attraction as described by Newtonian mechanics but rather arises from the curvature of spacetime. The greater the mass or energy of an object, the greater the curvature of spacetime around it. Physical objects do not attract each other at a distance through forces but instead move along geodesic paths in the curved spacetime, which results in gravitational effects that we observe as the attraction of bodies.

By combining the principles of the Equivalence of Gravity and Acceleration and the Curvature of Spacetime due to Mass and Energy (or more specifically, the distribution of mass and energy), Einstein formulated the gravitational equations of the General Theory of Relativity, describing how the distribution of mass and energy curves spacetime and influences the trajectories (geodesics) of physical objects.

In simplified form, Einstein's gravitational equations, describing the curvature of spacetime due to mass and energy, can be expressed as:

$$R\mu\nu - (1/2)Rg\mu\nu = 8\pi G\, T\mu\nu$$

where:
$R\mu\nu$ - Riemann curvature tensor describing the curvature of spacetime,
R - scalar curvature of Ricci, which is the trace of the Riemann tensor.
$g\mu\nu$ - metric tensor describing the spacetime metric,
$T\mu\nu$ is the energy-momentum tensor describing the distribution of mass and energy in spacetime,
G - gravitational constant,
π - the number pi (approximately 3.14159).

This equation is used to describe gravity in Einstein's *General Theory of Relativity*. It indicates how the curvature of spacetime is related to the distribution of mass and energy in space and how physical objects move within this curved spacetime.

Relativistic effects of Einstein's General Theory of Relativity (GTR). It's worth noting that the full Einstein's gravitational equations are far more complex than this simplified formula, and their solutions describe various interesting relativistic effects related to the curvature of spacetime, such as spacetime dilation, the gravitational redshift effect, gravitational lensing, or the Lense-Thirring effect.

Spacetime Dilation. In the presence of gravity, time flows slower in a stronger gravitational field. This is known as spacetime dilation and was one of the first experimental proofs of the correctness of the General Theory of Relativity. An example is time dilation around a black hole. While spacetime dilation in the *Special Theory of Relativity* (STR) results from differences in velocities, occurring when systems move at different speeds relative to each other (time is measured more slowly in a slower-moving frame), spacetime dilation in the General Theory of Relativity is related to the magnitude of the gravitational field. The greater the gravity (curvature of spacetime), the greater the spacetime dilation.

Effect of Gravitational Redshift. Gravity causes a redshift (shift towards longer wavelengths) of light arriving from areas with a stronger gravitational field[39]. It warps spacetime around masses, which affects the wavelength of light. Consequently, light waves stretch and shift towards the red end of the spectrum. This effect is often observed in the context of studying black holes, neutron stars, and other astronomical objects with high masses.

Gravitational Lensing. Gravity curves spacetime around masses, leading to the bending of the trajectories of physical objects. When we observe a distant object in the universe, and there is a massive body (e.g., a galaxy or a black hole) between that object and us, the curvature of spacetime around that body also bends the path of the light traveling from the object to us. This means that the object appears to change its position (it shifts).

> Gravitational lensing by galaxies seemed to surprise many when first found in 1979, even if it should not have. Now such lensing, along with its stellar size counterpart, have

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[39] In general, the redshift effect is a physical phenomenon associated with the stretching of an electromagnetic wave. When a light source moves away from an observer, the electromagnetic wave shifts towards longer wavelengths, resulting in the observation of the colour red. The effect of gravitational redshift is a specific case of the shift of the wave towards the red end of the spectrum.

> become tools for astronomy, used for example to infer the distribution of mass within galaxies, the distribution of dark matter, the properties of distant galaxies, and the presence of new exoplanets. Recently, magnification due to microlensing was used to determine properties of a binary system containing a white dwarf and a Sun-like star[40].

In other words, when we look at a distant cosmic object, such as a star, and there is a massive galaxy between us and that star, the light from that star is bent by the gravitational field of the galaxy. As a result of this bending, the observed star appears to be in a different position in the sky than would be expected if the gravity of the massive galaxy did not curve the trajectory of the star's light. This leads to an apparent shift in the star's position in the sky due to the disturbance (curvature) of the star's light by the galaxy located between the star and the observer on Earth.

Lense-Thirring Effect (*Frame-Dragging*). Gravity also causes an effect of shifting objects in rotational motion. This is known as the Lense-Thirring effect or frame-dragging effect. According to this effect, a rotating massive object (e.g., a star or a black hole) curves space and time around itself. As a result, space and time ‘swirl’ around the massive object. For an observer located outside this gravitational field, objects in the rotating space and time appear to be ‘shifted’ in the direction of rotation. This effect has been experimentally confirmed in scientific research and is significant in astronautics and in the study of objects (systems) subjected to the influences of gravity and rotation.

3.1.3. Quantum Physics

The dual nature of electromagnetic radiation

The concept of the dual nature of electromagnetic radiation (*wave-like* and *particle-like*) emerged during the contemplation and empirical investigation of blackbody radiation, the photochemical effect, and the Compton effect. This concept allowed for the construction of more accurate (empirically consistent) structural models of the atom.

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[40] Abhay Ashtekar (editor in chief) 2014, p. 7, https://www.researchgate.net/publication/265967015_General_Relativity_and_Gravitation_A_Centennial_Perspective

Blackbody radiation is the type of radiation emitted by a perfectly black object that completely absorbs incident radiation. According to Newtonian mechanics, energy is related to the wavelength of radiation - the shorter the wavelength (higher frequency), the higher the energy. In the visible spectrum, different wavelengths are perceived as different colors. The longest wavelengths correspond to the color red, and the shortest to violet. It is also known that a heated object changes its color from dark red to bright red, white, bluish, and eventually violet. This suggests that energy must be transferred to increasingly shorter wavelengths, and ultimately, all the energy should concentrate in the ultraviolet region (the so-called ultraviolet catastrophe). However, experiments did not confirm the existence of the 'ultraviolet catastrophe'; theoretical predictions matched experiments only for the red end of the electromagnetic spectrum.

In December 1900, the German physicist *Max Planck* (1858-1947) presented the law of blackbody radiation at a meeting of the German Physical Society, which, in a sense, marked the birth of quantum physics[41]. According to Planck, radiation has not only a wave-like but also a particle-like character, meaning that the energy of radiation is contained in specific quantized units (quanta) - small for red light and large for ultraviolet. A quantum is a discrete amount of energy that a system can absorb or transfer in a single interaction with another system. The energy of a quantum is proportional to the frequency of the radiation: $E = h\nu$, where h is Planck's constant (6.62697×10^{-34} Js), and ν is the frequency. Planck's constant is an algebraic expression that enables the precise determination of the spectral distribution of blackbody radiation. Planck's hypothesis was initially considered only a useful theoretical fiction but soon gained serious scientific status. In 1905, Einstein used it to explain the photoelectric effect, and in 1913, Niels Bohr applied it to the theory of atomic structure.

The photoelectric effect involves the emission of electrons from the surface of objects (it is currently used in photocells, solar panels, photodiodes, etc.). According to classical electrodynamics, assuming the wave nature of radiation, one would expect the kinetic energy of such electrons to depend on the intensity of the radiation. However, experimental observations showed that the energy of the emitted electrons depends solely on the frequency of the radiation. The explanation of this phenomenon was impossible within classical

[41] Quantum mechanics as a distinct physical theory was independently formulated in 1925 by Erwin Schrödinger (1887-1961) and Werner Heisenberg (1901-1976).

electrodynamics. *Albert Einstein* (1879-1955) proposed an explanation for the photoelectric effect by assuming that radiation has a quantum nature. It is postulated that the energy of light (radiation) is carried in specific discrete packets (quanta) rather than continuously. Radiation can be interpreted as a stream of photons, each having mass, momentum, and energy, moving at the speed of light. Both the emission and absorption of light by objects, as well as the energy of radiation, are transmitted in a quantized, non-continuous manner.

The hypothesis of the quantum nature of radiation (photons) was experimentally confirmed in 1923 by the Compton effect. *Arthur H. Compton* (1892-1962) studied the scattering of X-rays and gamma rays in light materials on free or weakly bound electrons. The measurement results were inconsistent with predictions based on the classical theory of electromagnetic wave scattering on electric charges. A satisfactory explanation was only possible by assuming that scattering was caused by collisions between individual quanta of radiation and electrons.

20th-century atomic models. The concept of the atom, whose combinations form the material world, dates back to antiquity. Currently, we will focus on contemporary concepts.

In 1904, *Joseph John Thomson* (1856-1940) proposed an atomic model in which the atom is treated as a homogeneous positively charged sphere with negatively charged electrons inside. If the electron configuration is stable, we have chemically inactive elements, while a less stable configuration leads to chemically active elements.

In 1911, *Ernest Rutherford* (1871-1937) conducted an experiment involving the passage of alpha particles through a thin gold foil. The distribution of their scattering definitively disproved Thomson's model. Rutherford explained the observed scattering by proposing that all of an atom's mass is concentrated in a tiny nucleus with a positive charge (proton) capable of retaining even dozens of electrons. This model with a massive positively charged center allowed for the distinction between properties of matter determined by the nucleus's mass and charge and those dependent on the atom's overall structure. It also enabled the classification of atoms based on the number of positive charges (protons). This led to the concept of atomic number, which represents the number of protons in an atomic nucleus, and atoms with the same number of protons are atoms of the same element.

In 1913, *Niels Bohr* (1885-1962) proposed his own atomic model[42], in which the limitations of Rutherford's model were removed. On the basis of his model, it was not possible to explain the stability of atoms and the discrete (quantized) nature of the radiation spectrum emitted by atoms. Bohr formulated *classical mechanics postulates:* the interaction between electrons and the nucleus has an electrical character, and the energy of electrons is the sum of kinetic energy and potential electric interactions. He then formulated the *quantum postulates*:

1. Quantization condition - among all electron orbits allowed by classical electrodynamics, only certain orbits, called allowed, stationary, or quantized orbits, are realized in an atom. These orbits are distinguished by the fact that the angular momentum is a multiple of Planck's constant divided by 2π.

2. An electron on an allowed orbit neither emits nor absorbs energy; the total energy of the electron on an allowed (stationary, quantized) orbit remains unchanged.

3. Postulate of radiation - if an electron jumps from a higher orbit to a lower allowed orbit (closer to the nucleus), it emits a photon, and if it jumps from a lower orbit to a higher allowed orbit, it absorbs a photon.

The dual nature of matter

De Broglie's hypothesis of matters waves. Louis de Broglie (1892-1987) presented the hypothesis of the particle-wave nature of matter in his work *Recherches sur la théorie des quanta* in 1924. Not only radiation but also material particles exhibit both particle-like and wave-like behaviors in addition to their classical particle behavior. Just as a photon is associated with a certain light wave (radiation), a material particle is associated with a specific matter wave that describes its motion. All particles, not just photons, coexist with waves (i.e., they are transported in waves that encompass them). Material particles and photons (*quantum of light*) are packets of waves carrying energy and momentum.

De Broglie's philosophical rationale for this hypothesis was the observation that the universe consists solely of matter and radiation, and nature is symmetric in many ways. What circular orbits were to Plato, the harmony of whole numbers to Pythagoras, or regular polyhedra to Kepler, symmetry between particles and waves was to

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[42] In 1915, Arnold Sommerfeld (1868-1951) generalized Niels Bohr's theory to the case of general elliptical orbits, while also taking into account the relativistic dependence of the electron's mass on its velocity.

De Broglie. The concept of matter waves and the particle-like nature of radiation led to the downfall of classical physical theories. As a result, quantum physics has emerged, which, in simplified terms, is based on the concept of *the dual nature of electromagnetic* radiation (quantum electrodynamics) and *the dual nature of matter* (quantum mechanics).

Schrödinger's Wave Mechanics

The Austrian physicist Erwin Schrödinger (1887-1961), continuing the work of de Broglie, formalized the wave aspect of matter through a wave function defined by Schrödinger's equation. It describes changes over time in a special quantity denoted by the symbol ψ (the wave function), which represents the de Broglie wave associated not only with electrons but with any particle. Schrödinger's equation is the fundamental equation in quantum theory that describes the behavior of quantum systems, such as atoms, molecules, and other microscale systems.

The general form of the Schrödinger equation for the time-independent Hamiltonian H is as follows:

$$\Psi(r, t) = \Psi(r) = -\hbar^2/2\mu\nabla^2\Psi(r) + V(r)\Psi(r)$$

where:

$\Psi(r, t)$ is a wave function that depends on position (r) and time (t).

$\hbar$ - Planck's constant divided by 2π (reduced Planck constant).

μ - the mass of the particle.

∇^2 - the Laplace operator, which is used to calculate the second derivative of the wave function with respect to position.

$V(r)$ - a potential that depends on the location.

The Schrödinger equation describes the evolution of the wave function Ψ over time and predicts its spatial distribution based on the potential $V(r)$ and other initial conditions. There are various versions of this equation, depending on the type of microscale system and factors taken into account, such as particle spin. It is one of the key equations in quantum physics.

The Schrödinger equation assigns the de Broglie wave to any particle and any quantum system of particles. If the mass of a particle and the forces acting on it (whether electromagnetic or gravitational) are known, then the Schrödinger equation indicates the possible waves associated with that particle. Moreover, when the particle and the system of forces acting on it are given, wave functions for all possible energy values can be calculated.

In Schrödinger's interpretation, operators representing observations are independent of time, and changes in the states of particles are described by the evolution of the wave function. This means that if the wave function is well-defined, it is possible to precisely determine, for example, the position and momentum of a particle.

Experiments conducted by *C.J. Davisson* and *G.P. Thomson*, in relation to electrons, confirmed their wave nature and, more broadly, the wave nature of any particles. The American physicist Clinton Joseph Davisson (1881-1958) passed a beam of electrons through a crystal of nickel. The angular distributions of electrons reflected from the crystal were quite remarkable. He concluded that such results depended on the arrangement of atoms in the crystal. After consulting with Max Born (1882-1970) and a modified experiment conducted together with *Lester Germer* in 1927, he associated the results with de Broglie's hypothesis of the wave-like nature of particles, which explained them satisfactorily. British physicist *George Paget Thomson* (1892-1975), the son of Joseph John Thomson, who discovered the electron, used a different experimental method. He passed a beam of electrons with an energy of several kiloelectronvolts through a thin celluloid foil and observed the diffraction patterns produced in this way. The results were consistent with de Broglie's hypothesis. In 1937, C.J. Davisson and G.P. Thomson shared the Nobel Prize in Physics for experimentally confirming the wave properties of particles and discovering electron diffraction.

Heisenberg's Matrix Quantum Mechanics

The Schrödinger equation describes changes over time in the wave function Ψ, representing the de Broglie wave characterizing an electron or any particle. A bit earlier, in 1925, Werner Heisenberg (1901-1976) laid the foundations for what is known as matrix mechanics. He noticed that all observable properties of electrons, considered as particles, are related not to one but to two of their states on two different orbits (when they transition from one energy state to another) as they revolve around the nucleus. The mathematical description of these two states requires the use of not ordinary numbers but arrays of numbers. Heisenberg constructed mathematical tables for such arrays. It was later found that such tables already existed in mathematics under the name matrices, and there was a well-developed calculus performed on these matrices. A noteworthy fact is that matrix multiplication is not commutative (matrices do not commute).

In Heisenberg's quantum mechanics, operations are not performed on the wave function but on operators representing observable physical quantities such as position, momentum, spin, and so on. The main equation in Heisenberg's quantum mechanics is the Heisenberg equation of motion, which describes the evolution of operators over time.

The general form of the Heisenberg equation of motion for operator A (representing an observable physical quantity) is as follows:

$$\frac{dA}{dt} = \frac{1}{i\hbar}\left[A, H\right]$$

where: $\frac{dA}{dt}$ - the time derivative of operator A.

$\frac{1}{i\hbar}$ - element of quantum mechanics formalism.

[A, H] - the commutator of operator A and Hamiltonian H (energy operator).

The Heisenberg equation in the context of matrix calculus takes the following form:

$$\frac{d\hat{A}}{dt} = \frac{1}{i\hbar}\left[\hat{A}, \hat{H}\right]$$

where: $\frac{d\hat{A}}{dt}$ - the time derivative of the matrix representing operator A (we study how operator A changes over time).

$\frac{1}{i\hbar}$ - element of quantum mechanics formalism.

$\left[\hat{A}, \hat{H}\right]$ - the commutator of two matrices that represent the operators A and H.

The term '*commutator*' in the discussed context means obtaining different results from performed operations in a different order (non-commutativity of operations). In the Heisenberg equation of motion, the commutator [A, H] measures how the operator A changes over time in response to the Hamiltonian H, which represents the system's energy. This equation describes the evolution of the operator A over time. In practice, by solving the Heisenberg equation of motion, we can obtain the evolution of operators representing various observable quantities, such as position, momentum, spin, and so on. This allows us to predict how the values of these quantities change over time. However, observation operators change over time, and furthermore, operators like position and momentum are non-commutative, which means that simultaneous measurement of position and momentum with arbitrary precision is impossible.

Over time, it turned out that matrix quantum mechanics leads to the same results in describing the behavior of electrons or other particles as Schrödinger's wave quantum mechanics. However, Heisenberg's approach was based on matrix calculations, which physicists were not using at the time, and for this reason, his concept was not widely accepted. Therefore, it can be said that both approaches are equivalent and provide the same results for experimental predictions. The choice between them depends solely on mathematical and interpretational convenience, which is appropriate for a particular quantum mechanics problem.

The Copenhagen Interpretation of Quantum Mechanics (CI)

The empirical confirmation of the dual nature of electromagnetic radiation and matter initiated the era of quantum physics (quantum electrodynamics and quantum mechanics), contrasting classical physics (classical electrodynamics and classical mechanics):

> The complete break with classical physics comes with the realization that not just photons and electrons but all “particles” and all “waves” are in fact a mixture of wave and particle. It just happens that in our everyday world the particle component overwhelmingly dominates the mixture in the case of, say, a bowling ball, or a house. The wave aspect is still there, in accordance with the relation $p\lambda = h$, although it is totally, insignificant. In the world of the very small, where particle and wave aspects of reality are equally significant, things do not behave in any way that we can understand from our experience of the everyday world. It isn't just that Bohr's atom with its electron "orbits" is a false picture; all pictures are false, and there is no physical

> analogy we can make to understand what goes on inside atoms, Atoms behave like atoms, nothing else[43].

In the 1920s, a group of scientists in Copenhagen, including Niels Bohr, worked on the foundations of quantum physics. Among its members were *Max Born*, *David Bohm*, *Werner Heisenberg*, and *Paul Dirac*. Due to the paradoxical consequences arising from the formalism of quantum physics, there was a need for a substantive interpretation of this formalism. One of the most important interpretations was developed by the scientists associated with Niels Bohr in Copenhagen, and it is known as *the Copenhagen Interpretation of quantum physics.* The essence of this interpretation can be summarized in the following principles:

1. the probabilistic interpretation of the wave function by Max Born and its collapse,
2. Werner Heisenberg's uncertainty principle,
3. the Complementarity and Correspondence principles of Niels Bohr,
4. Werner Heisenberg's uncertainty principle,
5. the principle of superposition,
6. the existence of quantum entanglement,
7. the fundamental role of measurement,
8. non-local realism.

Probabilistic interpretation of the wave function and its collapse: The physical significance of the Schrödinger wave function is not clear. In 1926, Max Born proposed a widely accepted probabilistic interpretation of the wave function in his article *Zur Quantenmechanik der Stossvorgange* (On the quantum mechanics of collision processes). He believed that the wave function is a purely mathematical entity interpreted probabilistically; in other words, it is a probability wave described by this equation. The wave function itself does not have a physical meaning. However, the square of its modulus, $|\psi|^2$, represents the probability density of finding a particle in a given volume element $d\tau$. So, the square of the absolute value of the wave function $|\psi|^2$ represents the probability density of finding the particle. Essentially, the particle can be found in any location in space, but the chances of finding it in some places are high, while in others, they are low. Thus, it is more probable to find the particle where the wave function has a high value than where it has a low

[43] John Gribbin (1991), *In Search of Schrodinger Cay. Quantum Physics and Reality,* Black Swan, pp. 91-92.

value. We can never be certain of the particle's position; we can only calculate the probability of finding it at a specific point in space (the position of the particle is uncertain in a strict sense).

When examining the value of the wave function, where there is a high probability of finding the particle, the wave function "collapses" under the influence of observation, revealing (actualizing) the particle that would not exist without the act of observation (measurement). Measurement introduces a disturbance into the system under study, and the quantum state "collapses" to one of the possible states; we obtain one concrete observed result, and the quantum system loses its superposition (particles can no longer exist in multiple states simultaneously).

The Uncertainty Principle: Max Born's interpretation - the possibility of determining only the probability of the particles' positions and Niels Bohr's principle of complementarity of temporal-spatial and causal descriptions - was further developed by Werner Heisenberg. In 1927, in his paper *Uber den anschaulichen Inhalt der quanten-theoretischen Kinematic und Mechani*k (On the perceptual content of quantum theoretical kinematics and mechanics), Heisenberg made a significant discovery that sparked lively discussions among physicists. He formulated the principle of uncertainty (indeterminacy), which states that it is impossible to simultaneously and precisely determine the position and momentum of an electron (or other physical quantities). Position is a property assigned to a particle, and momentum belongs to the wave. The more accurately we know the particle's position, the less information we have about its momentum (the product of mass and velocity; it determines the direction and speed of motion, i.e., the wave). Conversely, knowing the particle's momentum excludes an accurate determination of its position. Measuring position and momentum is therefore associated with a certain probability, and the measurement result is a probability distribution.

Mathematically, the uncertainty principle is expressed in the form of Heisenberg's inequality: $\Delta x \, \Delta p \geq \hbar/2\pi$, where Δx represents the uncertainty in position, Δp is the uncertainty in momentum, and $\hbar$ is the reduced Planck constant or Dirac's constant (the quantum of angular momentum), which is approximately $1.054571817 \ldots \times 10^{-34}$ J s = $6.582119569 \ldots \times 10^{-16}$ eV s.

In this context, quantum physics significantly departs from the determinism of classical physics. In the framework of Newtonian mechanics, knowing the precise positions and moments of all particles in the Universe was sufficient to accurately predict its entire future. However, in quantum mechanics, the future is inherently unpredictable. The situation is different when it comes to the past; calculations can be made to determine the positions of particles for selected time intervals in the past.

The uncertainty arises because measurement always involves interference (in the form of an energetic interaction) between the measuring apparatus and the object being measured. A measurement is essentially an interaction between the measuring instrument and the measured object. On a macroscopic scale, measurement does not disturb the object, but at the level of elementary particles, a measurement (conducted with the use of photons) results in the collision of a photon (measurement instrument) with an electron, leading to the 'kickback' of the electron and thereby disrupting its position. Heisenberg posited that uncertainty is not an imperfection in measurements but an inherent characteristic of the subatomic world. Therefore, it must be accepted as a fundamental principle of quantum mechanics that simultaneous and precise measurements of certain pairs of physical quantities (especially position and momentum or time and energy) are impossible.

In 1927, *Niels Bohr* (1885-1962) formulated two principles: *complementarity* and *correspondence*.

The principle of complementarity postulates that it is impossible to conduct a single experiment that can simultaneously describe such properties of a quantum system that are complementary, mutually completing and mutually exclusive (e.g., spatiotemporal description and causal description, continuity and discontinuity, particle-like and wave-like descriptions). Although a complete description of particles requires the consideration of contradictory characteristics, each feature must be determined separately. In certain situations, a particle behaves like a particle, and in other situations, it behaves like a wave. In this sense, the principle of complementarity states that the behavior of particles depends on the specific design of the experiment or measurement being carried out. If an experiment is designed to reveal the wave-like aspect, the particle-like behavior is concealed, and vice versa. However, no particle ever behaves simultaneously as both a particle and a wave.

The principle of correspondence demands that for large quantum numbers, large bodies, and high energies, the principles of quantum physics asymptotically converge to the principles of classical physics. The new theory (e.g., quantum mechanics, quantum electrodynamics, special theory of relativity, general theory of relativity) and the old theory (e.g., classical mechanics, classical electrodynamics, Newtonian mechanics, Newton's theory of gravity) must overlap and agree with each other to the extent that differences in their assumptions do not play a significant role.

The principle of superposition states that in quantum systems, particles can exist in a superposition of states, meaning they can exist in multiple states simultaneously with specific probabilities. Only when a measurement is made does the state reduce to one specific outcome among the many possible ones.

The existence of quantum entanglement. Schrödinger introduced the term 'quantum entanglement' in 1935 to extend quantum analysis to systems of two or more particles. Entanglement can be considered in epistemic or ontic contexts.

Epistemic entanglement means that the descriptions of states of two or more 'entangled' particles (systems) are mutually dependent. On the one hand, a complete description of one of the particles is impossible without considering the state of the other particle. On the other hand, each observation (measurement) of one particle immediately predicts the state of the other 'entangled' particle. Each particle transmits information instantaneously to the other, regardless of the distance separating them. According to the Copenhagen interpretation, making a measurement (observation) of one of the particles instantly disrupts the state of the other particle. In other words, the state of two separate 'entangled' particles remains connected, so measuring one particle immediately determines the state of the other, regardless of the distance between them.

Ontic entanglement means that particles that have been in close contact remain 'entangled' in the sense that any change in the state of one particle instantly initiates an identical change in the other particle, regardless of the distance at which they have been separated. This phenomenon is difficult to explain within the framework of intuition shaped by classical physics. Clearly, ontic entanglement is logically prior to epistemic entanglement; without ontic entanglement, it would not make sense to discuss epistemic entanglement.

According to E. Schrödinger, if two separated quantum objects enter into physical interaction during a specific time due to certain physical interactions (e.g., nuclear, electrical, magnetic, or gravitational), and they are separated again after some time, they can no longer be described in the same way as before the interaction.

> 1. When two systems, of which we know the states by their respective representatives, enter into temporary physical interaction due to known forces between them, and when after a time of mutual influence the systems separate again, then they can no longer be described in the same way as before, viz. by endowing each of them with a representative of its own. I would not call that one but rather the characteristic trait of quantum mechanics," the one that enforces its entire departure from classical lines of thought. By the interaction the two representatives (or Ψ-functions) have become entangled. To disentangle them we must gather further information by experiment, although we knew as much as anybody could possibly know about all that happened[44].

Quantum objects, due to their interaction, become 'entangled,' and the consequences reveal non-local correlations (such as the absence of speed limits or the breakdown of causality).

The nature of quantum entanglement was attempted to be explained by Albert Einstein (1879-1955) by introducing the concept of hidden variables, which represent information contained within the particles before reaching an 'entangled' state and subsequently influence the connected particles. However, the concept of hidden variables was disqualified by John Stewart Bell (1928-1990), who formulated Bell's theorem (Bell's inequalities), stating that no local theory with hidden variables can describe all phenomena of quantum mechanics. Among the original hypotheses explaining the effect of 'quantum entanglement' is one that associates 'quantum entanglement' with spacetime tunnels – namely, 'quantum entanglement' creates a geometric connection between two black holes that, through their interiors, form a spacetime tunnel. Contemporary quantum physics assumes (to some extent, it is still a hypothesis) that 'entanglement' is a real phenomenon, but there is still no complete understanding of the mechanism that describes the process of 'entanglement.'

The practical application of 'quantum entanglement' is seen in quantum cryptography. It is expected to involve the secure distribution of cryptographic keys free from any interference during transmission. Any attempt at such interference (e.g., unauthorized reading or changing of content) would result in the destruction of the information transmitted in the cryptographic key. Generally, the

[44] Erwin Schrödinger (1935), *Discussion of Probability Relations between Separated Systems* [in:] Mathematical Proceedings of the Cambridge Philosophical Society /Volume 31/Issue 04/, October 1935, p. 500.

transmission of information would rely on quantum teleportation, a process in which information about the state of one particle is conveyed to another 'entangled' particle over any distance, with the impossibility of copying the state of either particle. An appropriate cryptographic key would be required to decipher the information.

The Fundamental Role of Measurement. In the Copenhagen interpretation, the observer plays a significant role in making a measurement, as the act of observation disrupts the studied quantum system at the quantum level. Thus, it is the observer who decides which quantum state will be 'chosen' after the measurement. According to the Copenhagen interpretation, it doesn't make sense to talk about the objective existence of particles, mainly because it is only the detector that locates the particles (the wave function 'collapses') after the measurement; until the measurement, only the wave function exists. In other words, the measurement changes the quantum state, realizing only one of the many possible eigenstates of the measurement operator.

Local and Non-local Realism. Quantum mechanics challenges the concept of so-called *local realism,* which can be characterized by three principles: objectivity, the limitation of the speed of interactions, and causality.

1. Objectivity: Physical objects exist independently of any observers and have definite properties that exist whether or not they are observed or measured.
2. Limitation of the Speed of Interactions: Interactions between physical objects occur in a finite time and cannot exceed the speed of light, which is the fastest speed possible in the physical world.
3. Causality: There are specific, observer-independent causes that determine the outcomes of measurements; the role of the observer is merely to record these results.

On the other hand, quantum mechanics suggests that certain quantum effects may be *non-local* (i.e., inconsistent with local realism). In this case:

1. The negation of objectivity - reality is created by the observer in a measurement situation.
2. The negation of the limited speed of interactions; as seen in cases like 'quantum entanglement,' one particle can instantaneously influence another, regardless of the speed limitations or the distance between them.
3. The negation of causality in favor of probabilism.

It should be emphasized at this point that axioeventism, by considering events as a fundamental component of the Ontic Universe, does not exclude the existence of *facts* (Def. 6.3.) and *things* (Def. 10.2.), understood as events captured in minimal time intervals. Therefore, axioeventism encompasses both local and non-local understandings of realism (relevant to quantum mechanics). Resolutions in favour of local or non-local realism belong to the realm of physics and are in no way binding for the understanding of axioeventism.

Problems in Quantum Mechanics

We will focus on two thought experiments: the Einstein-Podolsky-Rosen (EPR) experiment and the experiment known as Schrödinger's cat.

EPR Experiment (Paradox). In 1935, Einstein, Podolsky, and Rosen published an article in which they provided the following description of physical reality:

> The element of the physical reality cannot be determined by a priori philosophical considerations, but must be found by an appeal to results of experiments and measurements. A comprehensive definition of reality is, however, unnecessary for our purpose. We shall be satisfied with the following criterion, which we regard as reasonable. *If, without is any way disturbing a system, we can predict with certainty (i.e., with probability equal to unity) the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity.* It seems to us that this criterion, while far from exhausting all possible ways of recognizing a physical reality, at least provides us with one such way, whenever the conditions set down in it occur. Regarded not as a necessary, but merely as a sufficient, condition of reality, this criterion is in agreement with classical as well as quantum-mechanical ideas of reality[45].

They then discussed several variants of the thought experiment and concluded that *the criterion of physical reality* they proposed is in contradiction with the Copenhagen interpretation of quantum mechanics, particularly failing to satisfy *the principles of local realism*.

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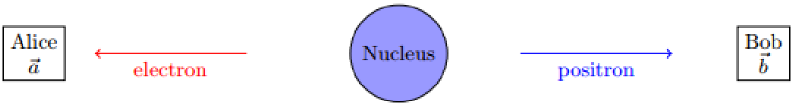
[45] A. Einstein, B. Podolsky and N. Rosen (1935), *Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?*, Phys. Rev. 47, pp. 777-778.

The EPR experiment focuses on determining the properties of two particles. Let's assume we have two particles, A and B, which were in contact for a certain arbitrary period of time, and their properties (e.g., position, momentum, or spin) were mutually correlated (Schrödinger referred to such particles as an entangled pair). Then these particles were separated over a significant distance. According to the Copenhagen interpretation of quantum mechanics, in a composite system of two particles, if we measure the properties (e.g., position, momentum, or spin) of the first particle, we immediately know the characteristics of the second particle, independently of the distance between them. Accepting such an interpretation would require us to reconcile with the fact that properties (characteristics) of the second particle, such as position, momentum, or spin, depend on the measurement process carried out concerning the first particle, even though the first particle has no influence on the second one.

Furthermore, according to the so-called Copenhagen interpretation of quantum mechanics, in a composite system of two particles, the position, momentum, or spin of the second particle does not have any objective existence at all until a measurement is made, regardless of what happens to the first particle. In the fundamental description of the world according to the Copenhagen school, there is no objective reality; there is instead action at a distance and a lack of causality. Einstein considered action at a distance (*quantum entanglement*) as absurd and something that unquestionably demonstrated the incompleteness of quantum mechanics; he even called it '*spooky action at a distance'*. Regarding the lack of causality, he expressed it as *'God does not play dice'*. Einstein, Podolski, and Rosen's 1935 article initiated an animated discussion on possible interpretations of quantum mechanics.

The EPR experiment is a thought experiment designed to demonstrate that the description of physical phenomena proposed by quantum mechanics is incomplete. This means that Einstein, Podolski, and Rosen believed that quantum mechanics should take into account *the so-called hidden variables*, which are essentially responsible for the paradoxical results obtained within quantum mechanics. If the world adheres to *local realism* - objects have definite properties regardless of whether we observe them or not, and spatially separated objects cannot influence each other instantaneously – then there must be some additional *hidden variables.* Incorporating them should eliminate both the entanglement effect and probabilism. If quantum mechanics were to be complete, it cannot be probabilistic.

Let's mention an illustration presented by Avinash Rustagi:



> For the thought experiment, let us imagine that we have two observers Alice and Bob who are spatially separated by a long distance. Midway between them is an unstable nucleus that decays emitting an electron that propagates towards Alice and a positron that propagates towards Bob. What everyone can agree on is the conservation of angular momentum before and after the decay. What this implies that the spins of the electron and positron if measured along the same quantization axis will be opposite. Let us assume that Alice makes a measurement on the spin of the electron first along the quantization axis of her choice namely $\vec{a}$ and measures +1/2. Now, if Bob were to measure the spin of the positron along the same quantization axis i.e. $\vec{a}$ then he will find the spin to be -1/2. This implies that there exists correlation between the measurements[46].

The EPR team concluded that the information regarding the measurement outcomes must be predetermined concerning the state of the electron and positron. Variables in which this information is predetermined are called hidden variables. The school represented by, among others, A. Einstein, Louis de Broglie, and D. Bohm, is often referred to as *the de Broglie-Bohm school.*

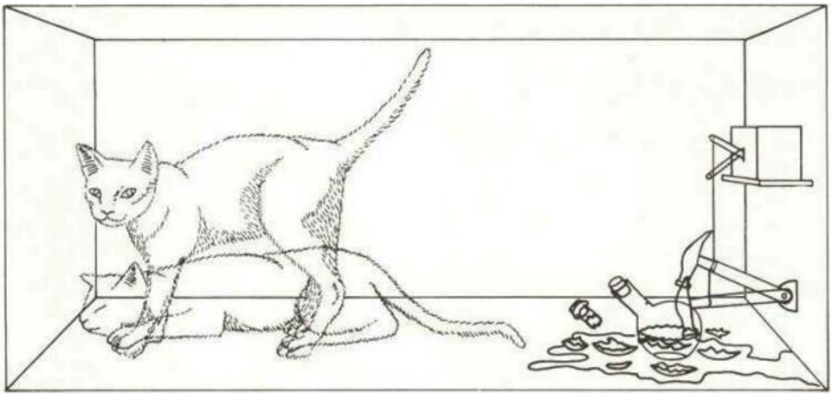
Schrödinger's cat. In the article '*Discussion of Probabilistic Relations Between Separated Systems*' published in 'Proceedings of the Cambridge Philosophical Society,' 31, 555 (1935), E. Schrödinger presented a thought experiment involving a cat to demonstrate the weaknesses of the Copenhagen interpretation.

Let's use the interpretation of John Gribbin and Bryce S. DeWitt:

> Yet the concept behind this thought experiment is very simple. Schrôdinger suggested that we should imagine a box that contains a radioactive source, a detector that records the presence of radioactive particles (a Geiger counter, perhaps), a glass bottle containing a poison such as cyanide, and a live cat. The apparatus in the box is arranged so that the detector is switched on for just long enough so

[46] Avinash Rustagi, *EPR Paradox and Bells' Inequality*, https://www.phys.ufl.edu/~avinash/Notes/Bells_Inequality/Notes.pdf

that there is a fifty-fifty chance that one of the atoms in the radioactive material will decay and that the detector will record a particle. If the detector does record such an event, then the glass container is crushed and the cat dies; if not, the cat lives. We have no way of knowing the outcome of this experiment until we open the box to look inside; radioactive decay occurs entirely by chance and is unpredictable except in a statistical sense. (…) The whole experiment, cat and all, is governed by the rule that the superposition is "real" until we look at the experiment, and that only at the instant of observation does the wave function collapse into one of the two states. Until we look inside, there is a radioactive sample that has both decayed and not decayed, a glass vessel of poison that is neither broken nor unbroken, and a cat that is both dead anf alive, neither alive nor dead[47].



Schrödinger's cat. The animal trapped in a room together with a Geiger counter and a hammer, which, upon discharge of the counter, smashes a flask of prussic acid. The counter contains a trace of radioactive material—just enough that in one hour there is a 50% chance one of the nuclei will decay and therefore an equal chance the cat will be poisoned. At the end of the hour the total wave function for the system will have a form in which the living cat and the dead cat are mixed in equal portions. Schrödinger felt that the wave mechanics that led to this paradox presented an unacceptable description of reality[48].

[47] John Gribbin (1991), *In Serach of Schrodinger's Cat*. Quantum Physics and Reality, A Black Swan Book, pp. 203-205.
[48] Bryce S. DeWitt (1970), *Quantum mechanics and reality,* Physics Today, Vol. 23, No. 9, September, p.156.

According to Schrödinger's idea, one should place the cat in a closed box along with a vial of poison, the release of which depends on the state of a quantum particle detector located on the box's wall. The detector is capable of registering two states of such particles, resulting in either breaking the vial or leaving it untouched. As a consequence, the cat either dies or remains alive. The situation gets complicated, however, when a quantum particle in a superposition of two states is directed at the detector.

So, should we then expect the cat to be simultaneously alive and dead? This would seem to be the implication of quantum mechanics' formalism, assuming that the complex state of the particle is transferred through the detector to the vial and, consequently, to the cat. According to the Copenhagen interpretation, the state of the cat is described as a superposition of states where it is both alive and dead until an observation is made. Schrödinger noted that complete knowledge of the entire physical system, regardless of whether it's a superposition or 'entangled states' does not imply full knowledge of its component parts. Incidentally, it was Schrödinger who introduced the term '*quantum entanglement'*. Schrödinger's experiment aimed to emphasize the paradoxical nature of quantum mechanics, in which an object can exist in multiple states before measurement. In other words, the quantum state collapses (the wave function determines the particle) into a specific observed event only after measurement. This paradox raises questions about when and under what conditions wave function collapse occurs and what the nature of reality is at the microscopic level.

Bell's Theorem and Bell Inequalities. The EPR paradox, as well as Schrödinger's cat paradox, lost their justifying power due to the research conducted by John Stewart Bell (1928-1990). In particular, the concept of hidden variables, which refers to information contained in particles before reaching an 'entangled state' was found to be inconsistent with quantum mechanics based on theoretical considerations and physical experiments. In other words, the notion of 'hidden variables' as presumed properties of quantum particles not included in quantum theory but still affecting the outcomes of experiments found no confirmation.

In 1964, *John S. Bell* published a paper in which, through a critical analysis of the EPR paradox, he challenged the classical concept of *local realism*:

> THE paradox of Einstein, Podolsky and Rosen [1] was advanced as an argument that quantum mechanics could not

> be a complete theory but should be supplemented by additional variables. These additional variables were to restore to the theory causality and locality [2]. In this note that idea will be formulated mathematically and shown to be incompatible with the statistical predictions of quantum mechanics. It is the requirement of locality, or more precisely that the result of a measurement on one system be unaffected by operations on a distant system with which it has interacted in the past, that creates the essential difficulty.
> There have been attempts [3] to show that even without such a separability or locality requirement no "hidden variable" interpretation of quantum mechanics is possible. These attempts have been examined elsewhere [4] and found wanting. Moreover, a hidden variable interpretation of elementary quantum theory [S] has been explicitly constructed. That particular interpretation has indeed a grossly nonlocal structure. This is characteristic, according to the result to be proved here, of any such theory which reproduces exactly the quantum mechanical predictions[49].

The essence of Bell's proposal can be formulated in the following Bell's theorem: *In certain experiments, all Local Realistic Theories* (LRT) *are incompatible with quantum mechanics*[50].

The key idea in Bell's theorem is the contradiction between local realism in classical physics and non-local realism in quantum mechanics. According to local realism, the properties of particles are determined by hidden variables that exist independently of measurements, and these properties can be described using a local theory (without mysterious long-distance interactions). In other words, it is a classical approach that assumes particles have well-defined properties, even when not measured. On the other hand, non-local realism in quantum mechanics allows for the existence of ‘entangled states’ with correlations that cannot be explained using local realism. In particular, quantum mechanics predicts that measurements on ’entangled particles’ can be instantaneously correlated, even if the particles are separated by large distances. Bell's theorem demonstrates that the predictions of quantum mechanics (non-local realism) and classical mechanics (local realism) are mutually contradictory.

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[49] John S. Bell (1964), *On the Einstein Podolsky Rosen Paradox*, Physics Vol.1. No, 3, p. 195.

[50] See: Reinhold A. Bertlmann, Nicolai Friis, *Theoretical Physics T2, Course of Lecture*, Univeristät Wien 2008, pp. 167- 168.

Bell's theorem is usually associated with *Bell's inequalities* – a set of mathematical inequalities that can be derived from local realism assumptions. These inequalities allow us to test whether the predictions of quantum mechanics correspond to the predictions of classical physics. The general idea of Bell's inequalities is that for a system of correlated particles (e.g., two polarized photons), certain mathematical inequalities must be satisfied if hidden variables or local theories that explain experimental results exist.

The Bell-CHSH (Clauser-Horne-Shimony-Holt) inequality is one of the most well-known Bell inequalities and has the following mathematical form:

$$S = |E(a, b) - E(a, b')| + |E(a', b) + E(a', b')| \leq 2$$

where:

S is the result of the Bell-CHSH inequality,

E(a, b) is the expected correlation value of the measurement results of two particles in an experiment in which we measure both particles at angles a and b,

a and a' are different settings of measurement angles for the first particle,

b and b' are different measurement angle settings for the second particle.

If the result of the Bell-CHSH inequality (S) is greater than 2, it means that the experiment's results are inconsistent with local realism and consistent with the predictions of quantum mechanics. A result greater than 2 serves as evidence of a violation of Bell's inequality and is a crucial element in Bell experiments that test the agreement between experimental results and quantum theory as compared to local realism. The correlation values E(a, b) and E(a', b') are calculated based on experimental measurement results and express the degree of correlation between the measurement results of two entangled particles at different angles.

Experimental tests of Bell's inequalities (commonly known as *Bell tests*) confirm their utility in justifying the quantum view of the world. In the 1980s, Anton Zeilinger and his team conducted experiments known as '*Aspect-Zeilinger experiments*' which demonstrated the violation of Bell's inequalities and provided experimental evidence of quantum non-locality while excluding local realism.

> As a conclusion, our results, in excellent agreement with quantum mechanics predictions, are to a high statistical

> accuracy a strong evidence against the whole class of realistic local theories; furthermore, no effect of the distance between measurements on the correlations was observed[51].

In the '*Aspect-Zeilinger experiments*' entangled photon pairs were used, and measurements of their polarizations were conducted in different directions. The results of these experiments demonstrated correlations between measurements that could not be explained by hidden local variables, as suggested by local realism. Instead, the results were consistent with the predictions of quantum mechanics, which assumes non-locality and quantum entanglement. These experiments were designed to provide experimental evidence of the violation of Bell's inequalities and to confirm quantum non-locality. Their primary goal was to refute local realism and hidden local variables.

In the 1990s, an original test was conducted, once again confirming the violation of Bell's inequalities.

> The best experiment up to now concerning tests of Bell inequalities has been performed by A. Zeilinger and his group [26] in the late 90ties. They used a revolutionary new source, a BBO crystal, for producing the entangled states and were able to fabricate a truly random and ultrafast electro-optical switch mechanism for the analyzers, see Fig. 10.2. In this way Alice couldn't get any information from Bob with velocities less than the speed of light, which means that the strict Einstein locality conditions have been fulfilled. The experimental value for the Bell parameter function in this experiment was determined to be
>
> $$S_{exp} = 2,73 \pm 0,02 \,, \qquad (10.17)$$
>
> in perfect agreement with quantum mechanics, which implies that LRT for describing Nature are ruled out, i.e. Nature contains a kind of nonlocality in the sense described above[52].

In this test, the basic idea was to attempt to check whether the measurement results of entangled pairs of particles are consistent with the principles of local realism. In principle, if there is a theory that is local and adheres to realism (meaning that objects have definite properties independent of the observer), the results of the

[51] Alain Aspect, Philippe Grangier, Gerard Roger (1981), *Experimental Tests of Realistic Local Theories via Bell's Theorem*, Physical Review Letters, Vol. 47, No 7, 17 August 1981, p. 463.

[52] Reinhold A. Bertlmann, and Nicolai Friis (2008), *Theoretical Physics T2, Course of Lecture*, Univeristät Wien, p. 170.

experiment should not violate certain Bell inequalities. However, the theoretical predictions of quantum mechanics suggest that the experiment's results can and do violate these inequalities.

Bell tests use entangled pairs of particles that are separated and subjected to measurements of various properties, such as spin. The Bell test involves different measurement angles and collects data on the correlations between the measurement results on both particles. Then, this data is analyzed using Bell inequalities, which are mathematical expressions that a local theory must satisfy. The results of Bell tests and many similar entanglement experiments show that the observed correlations between entangled particles violate Bell inequalities. This means that the experimental results are not consistent with the principles of local realism. These results are in line with the predictions of quantum mechanics and suggest that entangled particle pairs cannot be described by hidden local variables.

A bit more light (and problems) regarding 'quantum entanglement' was shed by the famous 2007 experiment by *A. Zeilinger*[53] and his team based on A.J. Leggett's theorem of incompatibility. Leggett's *incompatibility theorem*[54] is related to the study of the behavior of quantum systems in the context of so-called local hidden variables, which were theories assuming the existence of hidden variables that describe the behavior of quantum systems in a local way (without non-local interactions).

The experiment conducted in 2007 is one of the key experiments in the field of quantum entanglement, which took place in the Canary Islands, specifically on the islands of La Palma and Tenerife. This experiment was significant because it confirmed the phenomenon of 'quantum entanglement' over a large distance. In the experiment, a team of scientists used two devices located about 144 kilometers apart on the two islands. On the island of La Palma, they placed a source of entangled photons. 'Entangled' photons are pairs of photons that are closely related to each other due to specific properties, such as spin, polarization, or direction of motion. In this case, the photons were entangled based on polarization. Then, the entangled photons were separated, with one directed towards Tenerife and the other towards La Palma. The distance between these two islands is

[53] Simon Gröblacher, Tomasz Paterek, Rainer Kaltenbaek, CaslavBrukner, Marek Żukowski, Markus Aspelmeyer, Anton Zeilinger, *An experimental test of non-local realism*, Nature (446), May 2007.

54 A.J. Legget (2003), *Nonlocal Hidden-Variable Theories and Quantum Mechanics*: *An Incompability Theorem*, Foundation of Physics, Vol. 33, October 2003, pp. 1469-1493.

approximately 144 kilometers. There were detectors on both islands to precisely measure the polarization of the photons. It's worth noting that according to quantum mechanics, the polarization of a photon is not predetermined but exists in an undetermined state until measurement. It turned out that the measurement results on both islands were strongly correlated, even though the photon on one island was measured earlier than on the other. This constituted confirmation of the 'quantum entanglement' phenomenon over a vast distance.

The 2007 Zeilinger experiment was designed to test non-local realism, i.e., to answer the question of whether local hidden variables can explain observations in quantum mechanics without the need for non-local interactions. The results of the experiment were not inconsistent with Leggett's incompatibility theorem, which would suggest that non-local nature of quantum mechanics is compatible with the experimental results. However, despite confirming quantum entanglement over considerable distances, the measurement results did not violate Bell inequalities. Therefore, the experiment did not provide evidence that non-locality is necessary to explain observed quantum phenomena. It would seem that the results of the experiment are consistent with local realism, indicating that hidden local variables could explain the obtained results. Nonetheless, the authors of the experiment suggest that the concept of non-locality has a more promising future in quantum mechanics than local realism:

> We have experimentally excluded a class of important non-local hidden-variable theories. In an attempt to model quantum correlations of entangled states, the theories under consideration assume realism, a source emitting classical mixtures of polarized particles (for which Malus' law is valid) and arbitrary non-local dependencies via the measurement devices. Besides their natural assumptions, the main appealing feature of these theories is that they allow us both to model perfect correlations of entangled states and to explain all existing Bell-type experiments. We believe that the experimental exclusion of this particular class indicates that any non-local extension of quantum theory has to be highly counterintuitive. For example, the concept of ensembles of particles carrying definite polarization could fail. Furthermore, one could consider the breakdown of other assumptions that are implicit in our reasoning leading to the inequality. These include Aristotelian logic, counterfactual definiteness, absence of actions into the past or a world that is not completely deterministic [30]. We

> believe that our results lend strong support to the view that any future extension of quantum theory that is in agreement with experiments must abandon certain features of realistic descriptions[55].

Anton Zeilinger's experiment (with his team) in 2007 confirmed that entangled photons maintain their correlations even when separated by a distance of over 140 kilometers, in accordance with the predictions of quantum mechanics. However, it did not provide evidence of a violation of locality, including the notion that interactions or information can propagate faster than the speed of light.

It's important to recall that the Bell tests from the 1980s and 1990s (including the Aspect-Zeilinger experiments mentioned earlier) unequivocally demonstrated the violation of Bell inequalities, thus providing experimental evidence for quantum non-locality and ruling out local realism. However, these experiments were designed *a priori* to provide experimental evidence for the violation of Bell inequalities and the confirmation of quantum non-locality. Their primary goal was precisely to challenge local realism and the concept of hidden local variables. In contrast, Zeilinger's experiment in 2007 aimed to show that non-locality is not necessary to explain the observed phenomena; local variables are sufficient for an explanation. Furthermore, the Bell tests from the 1980s and 1990s typically used pairs of ‘entangled’ photons and measured their polarization in different directions, whereas the 2007 experiment employed a configuration where the entangled photon pair was separated by a considerable distance, and the measurement on one photon was performed earlier than on the other.

It's worth noting that the differences mentioned above are not fundamentally contradictory but stem from emphasizing different aspects in the theoretical assumptions of the research. As a result, these experiments provided various perspectives on the issue of quantum entanglement, locality, and non-locality in quantum mechanics.

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[55] Simon Gröblacher, Tomasz Paterek, Rainer Kaltenbaek, Caslav Brukner, Marek Żukowski, Markus Aspelmeyer, Anton Zeilinger, *An experimental test of non-local realism*, Nature (446), May 2007, p. 878.

Selected Interpretations of Quantum Mechanics

We have considered four selected interpretations of quantum mechanics. In the following table, their main characteristics are summarized and systematized (for comparison) based on the following criteria: the nature of the quantum object, the nature of measurement, the approach to 'quantum entanglement,' and the nature of physical reality (Table 3.1.).

	Quantum Object	**Measurement**	**Quantum Entanglement**	**Nature of Reality**
CI	Particle after wave function collapse	Collapse of the wave function into a single state	Probabilsm	Set of particles after wave function collapse
BBI	Real particles independent of observation	Description of particle trajectories	The effect of latent variable interaction	Hidden ('piloted') realisty
MWI	Real particles in separate universes	Generating separate universes	Interdependence of particle states	Infinity of separate universes
QIT	Collection of information and its evolution	Gathering of information	Interdependencies of information	Collection of informational structures

Table 3.1. Selected interpretations of quantum mechanics

The Copenhagen Interpretation of Quantum Mechanics (CI)

Quantum Object: According to CI, the quantum object (or particle system) is described by a wave function. Before measurement, it exists as a superposition of eigenstates described by the wave function. In this sense, it is not a specific object with fixed properties (as in classical mechanics) but a mathematical object, a mathematical description of the probability of obtaining different measurement outcomes. During measurement, the wave function 'collapses' into one of these eigenstates. It can be said that, according to CI, the particle only becomes a part of physical reality following a measurement by an observer.

Measurement: Before measurement, according to CI, the particle exists in a superposition of states, meaning it exists simultaneously in many possible states. The observer does not have knowledge of which state the particle is in among the many possibilities. At the moment of measurement of a specific quantity (e.g., position or momentum) by an observer, the superposition of states undergoes a 'collapse' into a single specific state with a certain probability. The concept of wave function collapse explains why the measurement results align with our macroscopic intuition. The CI places special emphasis on the observer as an active participant in the measurement process.

Quantum Entanglement: Quantum entanglement occurs when two or more particles are in a state that cannot be described as a combination of the independent states of each particle. This generally means that the properties of one particle are entangled with the properties of another particle in such a way that one cannot uniquely describe one particle without considering the state of the other particle. This phenomenon is one of the unique aspects of quantum mechanics that has no classical physics equivalent. In the Copenhagen interpretation of quantum mechanics, quantum entanglement is accepted as a real phenomenon in which two particles can be connected in such a way that the measurement of one particle can affect the state of the other, regardless of their distance. However, how this entanglement is interpreted and its implications for the concept of local realism remain open questions.

Nature of Reality: According to the CI of quantum mechanics, physical reality is described by mathematical wave equations (such as the Schrödinger equation), but it is not considered 'real' in the classical sense. In this interpretation, existing objects, such as electrons, are described by wave functions that represent the probability of finding these objects in a specific state. However, only at the moment of wave function collapse (a probabilistic process), the object acquires specific properties and becomes 'real' in an experimental sense (i.e., subject to experiments). Therefore, physical reality is closely tied to measurements made by observers. One could say that it constitutes a set of particles after the 'collapse' of the wave function.

The de Broglie-Bohm Interpretation (BBI)

Also known as the 'Pilot-Wave' or 'Guiding Wave,' it is an alternative interpretation of quantum mechanics proposed independently by Louis de Broglie and David Bohm in the 1920s and 1930s. This interpretation aims to preserve determinism in quantum mechanics and introduces the concept of 'pilot waves' that guide the behavior of subatomic particles. It maintains that each subatomic particle is both a material particle and a pilot wave. This pilot wave is an immaterial entity that guides the motion of the particle and influences its trajectory. The pilot wave and the trajectory it determines for the particle are the hidden variables in the Broglie-Bohm interpretation, whose existence was suspected in the context of the Einstein-Podolsky-Rosen (EPR) experiment.

Quantum Object. In the BBI, a quantum object is a real elementary particle, determined by two components: the wave function and the pilot wave. The wave function describes the probability of the particle's state or position within a set of particles in superposition. The pilot wave, on the other hand, is a mathematical object that contains hidden variables allowing the description of the real particle's motion. As a result, the particle moves according to the trajectory determined by the pilot wave while simultaneously interacting with the wave function. Since the quantum object is a real particle in this interpretation, the concept of the 'collapse' of the wave function, where the particle acquires reality, becomes irrelevant. In this interpretation, the quantum object is treated as a real physical entity with well-defined trajectories and positions (though hidden from the observer), even when unobserved. This interpretation is deterministic and posits the existence of hidden variables that determine the evolution of the quantum object (system).

Measurement. According to BBI, measurement is a process in which certain properties of the quantum object, particularly its trajectory, are measured. During measurement, the measuring apparatus interacts with the object, influencing the pilot wave that determines the trajectory and leading to specific results. Measurement provides information about the particle's state but does not in any way affect the evolution of the wave function or the trajectory of the particle. In the de Broglie-Bohm interpretation, there is no need to introduce a mechanism for the 'collapse' of the wave function during measurements. The wave function remains present and evolves continuously, with measurement providing additional information about the particle's trajectory. In other words, measurement indeed provides information about the particle's state, but it does not influence the evolution of the wave function or the particle's trajectory.

Quantum Entanglement. In the BBI, quantum entanglement is explained as an effect of the interaction of 'hidden' variables on elementary particles. Each particle has its own set of hidden variables that determine its trajectory and, in turn, influence the behavior of 'entangled' particles. In practice, this means that 'entangled' particles maintain their mutual correlations, but these correlations are explained by hidden variables and trajectories, rather than by instantaneous action at a distance.

Nature of Reality. Reality is considered 'hidden' or 'piloted' in the BBI because there are hidden variables that determine the behavior of quantum objects. A key element of this interpretation is the existence of pilot trajectories, which are actual trajectories along which subatomic particles move. In the BBI, reality is deterministic, meaning that quantum objects have well-defined positions and velocities at every moment, even if they are not fully known due to the lack of access to hidden variables. Elementary particles remain in specific states, regardless of measurements, and possess real trajectories determined by the pilot wave (which predicts particle motion based on the de Broglie-Bohm equations). This theory is local, implying that the influence of one particle on another is limited by a maximum speed in accordance with relativistic principles. Furthermore, this interpretation upholds determinism, meaning that the state of each particle is fully determined by the pilot waves that guide the motion of subatomic particles, with no room for probability.

The de Broglie-Bohm interpretation offers an alternative to other interpretations of quantum mechanics, addressing some issues related to the interpretation of measurements. However, although this interpretation resolves certain problems concerning the measurement in quantum mechanics, it is less popular among physicists than other approaches, such as the Copenhagen interpretation or Everettian many-worlds interpretation. Moreover, some critics point out its lack of mathematical economy and complexity compared to traditional formalisms of quantum mechanics, especially those used in the Copenhagen school.

The Many-Worlds Interpretation (MWI)

This theory, proposed by Hugh Everett III in 1957, is a controversial and unconventional interpretation of quantum mechanics, providing an alternative to traditional interpretations like the Copenhagen or the de Broglie-Bohm interpretation. The Everettian theory posits the existence of an infinite number of parallel universes or realities that coexist simultaneously.

Quantum Object. In MWI, the quantum object is a real particle described by a wave function that evolves according to the equations of quantum mechanics. Every possible quantum state that can result from a measurement leads immediately to the creation of a separate universe. In the context of the existence of objective particles, the many-worlds theory suggests that each quantum particle exists in multiple branches of the universe simultaneously. For example, if we measure the electron's spin along the z-axis, according to the many-worlds theory, multiple branches will emerge in which the spin points in different directions, such as up or down. Therefore, there are different universes in which you can find the electron with different spin values.

> This universe is constantly splitting into a stupendous number of branches, all resulting from the measurement like interactions between its myriads of components. Moreover, every quantum transition taking place on every star, in every galaxy, in every remote comer of the universe is splitting our local world on earth into myriads of copies of itself[56].

Measurement. In the MWI, measurement is a process in which every possible measurement outcome becomes a reality in a separate universe. There is no 'collapse' of the wave function into a single state, as seen in other interpretations like CI. Each possible measurement outcome leads to the immediate existence of a separate 'branch' of the universe or a 'potential' universe. In other words, each possible state that the quantum object could assume after a measurement is equally real and exists in its own universe. For example, if a measurement has two possible values, then after the measurement, there are two parallel branches of the universe in which the quantum object assumes the respective states.

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[56] Bryce S. DeWitt (1970), *Quantum mechanics and reality,* Physics Today, Vol. 23, No. 9, September, p.161.

In Everett's theory, there is no '*collapse'* of the wave function. Instead, according to this interpretation, the wave function of the system continually evolves deterministically according to Schrödinger's equation. Measurement does not cause a 'collapse,' but it makes the observer a part of the extended quantum system and evolves together with it in a many-world structure. In other words, each measurement result (possible state) is equally real but associated with a separate universe that exists in parallel.

In the many-worlds theory, there is virtually no need to introduce the concept of an observer who makes measurements because all possible measurement results materialize in different, independent universes. Therefore, measurement is perceived as a subjective act, but all its possible results exist objectively. In each universe, the observer experiences only one measurement result, constituting their subjective experience. For the observer, every universe is equally real and objective.

Quantum Entanglement. In MWI, quantum entanglement, understood as the interdependence of particle states, leads to the creation of multiple parallel 'branches' of the universe or 'potential' universes.

Nature of Reality. In MWI, physical reality is conceived as an infinite collection of distinct, real universes. In other words, there are many parallel realities that evolve independently, with each representing a different state of reality or a different possible history. There is only one overarching wave function that evolves according to Schrödinger's equations, and each possible measurement outcome exists in a separate universe. Ultimately, all these universes exist simultaneously. There is no preferred reality chosen in any way; all universes have the same ontological status.

The many-worlds theory has its proponents and critics in the worlds of physics and philosophy. Some physicists find it an attractive interpretation because it eliminates the need for introducing the mysterious collapse of the wave function and allows determinism to be maintained in quantum mechanics. However, for others, it may appear too abstract and challenging to accept due to the multitude of universes. It is worth emphasizing that the Everettian theory is not currently the dominant interpretation of quantum mechanics, but provides an interesting alternative in the philosophical debate surrounding quantum physics.

Quantum Information Theory (QIT)

This theory focuses on the role of quantum information in describing the behavior of quantum systems (objects).

Quantum Object. In QIT, a quantum object is understood as a particle (or a system of particles) described using information and its evolution. In other words, a quantum object does not have a definite location or trajectory in the classical sense but is described by a wave function that represents information about the quantum object's state. In this interpretation, a quantum object lacks full identity. Its state is associated with the information available to an observer, and this information can change during the object's response to the measurement process. In the context of QIT, a quantum object is treated as a specific information system, and quantum mechanics is the theory that describes its evolution and changes resulting from acquiring information during measurement.

Measurement. In QIT, measurement is understood as the process of gathering information about the state of a quantum object without the need for introducing the 'collapse' of the wave function. Measurement provides new information that reveals certain aspects of the quantum object, but it does not cause any change in the object's state as a result of the measurement. In this perspective, quantum mechanics appears as a theory that describes and predicts the outcomes of measurements, rather than a theory describing changes in real quantum objects.

Measurements made by observers allow for constructing models of quantum objects with a set of properties that do not change regardless of variations in observation methods or descriptions:

> In quantum experiments an observer may decide to measure a different set of complementary variables, thus gaining certainty about one or more variable at the expense of losing certainty about the other(s). Thus the measure of information in an individual experiment is not an invariant but depends on the specific experimental context. However the total uncertainty, or equivalently, the total information, is invariant under such transformation from one complete set of complementary variables to another. (…)
>
> It is beyond the scope of quantum physics to answer the question why events happen at all (that is, why the detectors clicks at all). Yet, if events happen, then they must happen randomly. The reason is the finiteness of the information. Any detailed description of the reality that would be able to give an unambiguous answer to Bell's question, that is, any

> description that would be able to arrive at an accurate and detailed prediction of the particular process resulting in a particular event, will necessarily include the definition of a number of ”hidden” properties of the system which would carry information as to which specific result will be observed for all possible future measurements. Therefore no answer can be given to Bell’s question, because otherwise, quantum system would carry more information that it is in principle available[57].

Quantum Entanglement. In QIT, 'quantum entanglement' is understood as a specific type of informational relationship between quantum objects, which does not necessarily imply direct physical interaction between them. A significant difference from, for example, CI is that 'quantum entanglement' is described here in the context of information and the evolution of information about the system's state, rather than as a form of direct physical interaction between objects. For example, let's assume that particles A and B are 'entangled' in a spin state, where they can have spin 'up' or 'down'. If a measurement on particle A yields the result 'up,' we learn that particle B cannot have spin 'down' (in accordance with the conservation of spin in entangled pairs). However, this does not mean that we know the exact spin of particle B. There is still some degree of uncertainty about its spin. In the informational interpretation, what we do on particle A can provide us with some information about particle B, but it does not give us full knowledge about it. There is no immediate transmission of information from one particle to another; nonetheless, our knowledge about the state of the second particle changes as a result of the measurement or interaction with the first. This is a key element of this interpretation, which is more focused on information and knowledge than on the direct transfer of information between particles.

Nature of Reality. In QIT, reality is understood as a set of informational structures, rather than an aggregate of specific entities with fixed, precisely determined states. Quantum objects are described using wave functions, mathematical constructs that represent information about the possible states of these objects. As objects undergo measurements, this information changes, and our knowledge about the objects' states becomes more precise.

QIT, therefore, focuses on information processing and its role in describing quantum mechanics. It assumes that a quantum system

[57] Caslav Brukner, Anton Zeillinger, *Information and fundamental elements of the structure of quantum theory*, https://arxiv.org/abs/quant-ph/0212084v1

(object) is a carrier of information, and measurement is nothing more than the process of extracting information from this system. The measurement result is a derivative of the interaction between the observer and the system. Since measurement is an act of gathering information, the 'collapse' of the wave function is not relevant; it is not treated as a physical process but rather as an update in the knowledge of the system's state.

A sufficient amount of information uniquely (deterministically) defines the state of a given quantum system (Object). This applies equally to the so-called 'quantum entanglement,' which, in the view of proponents of the informational interpretation of quantum mechanics, appears as an effect of a lack of information about the state of the quantum system before measurement, suggesting non-locality of interaction.

Philosophical Consequences of Selected Interpretations

Epistemology of Selected Interprettions. Two of the considered interpretations of quantum mechanics emphasize the significant role of measurement, namely CI and MWI. In CI, measurement carried out by an observer allows for knowledge due to the collapse of the wave function into a single state. On the one hand, measurement is practically a necessary condition for knowledge, and on the other hand, it limits the observer's ability to precisely measure certain parameters of quantum objects due to the uncertainty principle. In contrast, in MWI, measurement generates separate universes, between which there can be no interaction. The quantum states realized in separate universes, therefore, exclude the 'collapse' of the wave function for any individual universe.

In the BBI and QIT interpretations, measurement plays a much more modest role. According to BBI, every subatomic particle has a definite trajectory in space, regardless of whether we make a measurement or not. This means that there is an objective picture of reality independent of the observer. In QIT, measurement only provides information about subatomic particles; there is no interference with them.

Ontology of Selected Interpretations. In CI and MWI, physical reality is the result of measurement. It is either a set of particles (one reality) reduced to a single state through measurement-observation (Berkeley's *esse = percipi*), or a set of separate universes created by measurement (observation). In BBI, physical reality is treated as existing in reality without reference to measurement. There is a 'pilot wave' that guides the movement of subatomic particles. This wave is unobservable and acts as the hidden cause of particle motion. Furthermore, it essentially allows, for example, the simultaneous determination of the position and momentum of a particle, contrary to the principle of complementarity that applies in CI. While QIT does not directly address the ontic status of quantum objects (and thus the entire physical reality), it merely treats them as informational structures related to the knowing subject.

Axioeventistic Approach

The four interpretations of quantum mechanics we have selected also operate with ontological concepts of local and non-local realism. Therefore, it is necessary to specify them in axioeventistic terms. In *axioeventism*, five fundamental ontological positions are distinguished: *spiritualism, objective idealism, subjective idealism, realism*, and *eventism* (see: Chapter 10.2.1.). In relation to each element of the ontic universe in its static aspect, and especially concerning the natural reality (NR) of interest, one of the characteristic features is eventistic interactions, which result in occurrences. The philosophical position that considers events as constitutive elements of reality is called eventism[58].

Eventism, in the context of local and non-local realism discussed in quantum mechanics interpretations, is described by the following properties:

Objectivism – physical reality and its properties exist independently of any observations (independence from the knower); in agreement with local realism.

The speed of physical interactions depends on experimentally confirmed physical laws, which do not exclude speeds greater than the speed of light (in agreement with both local and non-local realism).

The existence of probabilistic determinism, of which classical determinism can be a particular case (in agreement with both local and non-local realism).

Now, we will conduct an axioeventistic interpretation of quantum mechanics considering the parameters in Table 3.1: Quantum Object, Measurement, Quantum Entanglement and Nature of Reality:

[58] It is easy to notice that *axioeventism* is a particular kind of eventism, namely one in which the value is elevated to the status of co-defining significance.

Quantum Object. Quantum mechanics researches quantum events (particles, states, systems) occurring on small time scales related to the subatomic reality.

Axioeventism distinguishes *Object* – any part of the Ontic Universe, *S-object* (Def. 2.6.) and *S-construct* (Def. 2.7.). For instance, *Object* could be some part of physical reality, later referred to as an electron. In this case, S-object is a material entity singled out in nature by a conscious subject according to adopted *identification principles* (Id_{prcp}), and S-construct is a certain model of the electron, developed and modified in accordance with *interpretative principle*s (Int_{prcp}).

Furthermore, axioeventism assumes that there exists an electron as an abstract-essential being, part of The *Reality of Abstract-Essential Structures* (RAES). In this latter sense, the electron is a static, timeless being, generally abstract-formal. One can only make approximate statements about it based on constructed successive S-constructs (verified theoretical models). Furthermore, the existence of the electron, as an S-object belonging to amorphous physical reality (*Object* – before measurement), should be considered as long as it has been correctly identified as such [*ontic truth*], despite the fact that asserting the existence of the electron requires, on the one hand, certain theoretical assumptions, and on the other hand, appropriate research equipment.

The electron as an *S-Construct*, being a relatively isolated system within physical reality, has a defined *g l o b a l s t r u c t u r e* (Def. 2.5.), including an *essential structure* (a set of essential, constitutive properties) and an *accidental structure* (a set of non-constitutive properties).

The *e s s e n t i a l p r o p e r t i e s* of the electron include mass, electric charge, and spin.

Mass (rest mass): $m_e = 9.10938 \times 10^{-31}$ kg, which is approximately 1/1836 of the mass of a proton. It is one of the smallest known subatomic particles.

Electric charge. The electron is negatively charged (the proton is positively charged); the absolute value of the electron's charge is the same as that of the proton and is called the elementary charge: $e = 1.6 \times 10^{-19}$C.

Spin of the electron. A property related to the angular momentum of the particle; however, it is not the same as the physical rotation or rotation of the electron. It is an abstract property describing how the electron carries angular momentum. The electron's spin has a fixed value of 1/2 in Planck units ($\hbar/2$), meaning it can only take discrete values and has two possible orientations. For the electron, these are +1/2 (spin 'up') and -1/2 (spin 'down'). These designations are arbitrary and have no physical significance.

The mass, electric charge, and spin of the electron are internal properties that exist regardless of the presence of other objects in the surroundings. These are the essential properties of the electron, constituting its es*sential structure*. They define what an electron is and remain unchanged, independent of the environment in which the electron exists.

The *accidental properties* of the electron include: position, momentum, dualism corpuscular-wave, electromagnetic interaction, position, and Pauli's prohibition.

Electron's position: In quantum mechanics, the electron's position is described by the wave function, which estimates the probabilities of finding the electron in a specific region of space.

Electron's momentum: In classical mechanics, a particle's momentum can be expressed as the product of its mass (m) and velocity (v) and is described by the equation $p = mv$. In quantum mechanics, momentum is represented by the mathematical momentum operator, which acts on the wave function of the particle and is one of the operators present in the Schrödinger equations that describe particle behavior in quantum mechanics. The momentum operator is defined according to the equation:

$$p = -i\hbar\nabla$$

where p is the momentum operator, $\hbar$ is the reduced Planck constant divided by $2\pi2$, and ∇ is the gradient operator.

In quantum mechanics, the properties of the position and momentum of an electron are determined by *Heisenberg's uncertainty principle*, which means that it is impossible to precisely determine both the position and momentum of an electron simultaneously. The determination of the position and momentum of an electron relies on wave functions that describe the probability of finding the electron in a specific location and the distribution of its momentum in a given state.

Dualism corpuscular-wave. An electron exhibits both particle-like and wave-like properties. It behaves as both a particle (having mass and charge) and an electromagnetic wave with a specific wavelength.

Electromagnetic interaction. This is one of the four fundamental interactions in nature (alongside strong, weak, and gravitational interactions) and encompasses various aspects such as electric charges, the motion of charged particles, the propagation of electromagnetic waves, and magnetic interactions.

Pauli Exclusion Principle (*Pauli's prohibition*). Governs the behavior of fermions (particles with half-integer spin, such as electrons, protons, or neutrons). Concerning electrons, it states that there cannot be more than one electron in the same quantum state with the same spin value (they cannot have the same quantum values). This is why electrons occupy, for example, two different spin states: 'spin up' or 'spin down.'

Measurement. Let's take an *electron* as an example, which can exist in various energy states. Each such state is determined by a set of three quantum numbers: the principal quantum number (*n*), the orbital quantum number (*l*), and the magnetic spin quantum number (*m*). Therefore, an electron can exist in multiple states. Energy states of electrons (f*ermions*) exist discretely, meaning they are separate. Electrons occupy different energy levels because, in accordance with the Pauli exclusion principle, they cannot coexist with the same quantum number values. By the way, this differs in the case of photons (*bosons*), which can have various energies within a certain range and are not subject to the Pauli exclusion principle.

Let's now consider whether the *principle of superposition* in quantum mechanics (Copenhagen Interpretation - CI): a subatomic particle exists in multiple energy states simultaneously before measurement – does this mean that it *must* exist in a superposition before measurement or only that it *can* exist in a superposition.

In 1927, American physicists Clinton Davisson and Lester Germer conducted an experiment (*the Davisson-Germer experiment*) that confirmed de Broglie's hypothesis about the dualistic nature of matter particles. Electrons, like waves, exhibit interference phenomena and adhere to the principle of superposition of states, which is one of the fundamental aspects of quantum mechanics. The Schrödinger wave equation formalism, developed somewhat later, provided a more general mathematical description of electron behavior in quantum systems. This Schrödinger formalism describes the evolution of a quantum state over time using Schrödinger's equations. According to the Schrödinger equations, any particle (including the electron) can exist in multiple states simultaneously, meaning it remains in superposition.

In quantum mechanics, the state of a system is described by a wave function that contains information about the probability of finding a particle in a specific state. When we talk about *superposition*, it means that the wave function describing the system is a linear combination of many eigenstates of the system. This can be expressed mathematically as:

$$\Psi = \alpha\Psi_1 + \beta\Psi_2$$

where Ψ is the wave function, Ψ_1 and Ψ_2 are different eigenstates of the system, and α and β are coefficients that describe the probability of finding the system in each of these states. In practice, this means that a particle exists in many different states simultaneously, and it may manifest in different locations or have different properties, each with certain probabilities.

Niels Bohr's assumption, in the context of the Copenhagen Interpretation (CI), regarding the existence of an electron in a superposition of states before measurement, does not directly result from the formalism of Schrödinger's mechanics (which was developed somewhat later) or Heisenberg's mechanics. It is only an interpretation of the particle's state before measurement. The Schrödinger wave function is a mathematical description of the quantum state of a particle and its evolution over time, not necessarily related to any measurement. The wave function provides complete information about the quantum states of the particle but does not specify the specific measurement outcome. The particle's state before measurement is a mathematical description, and that state can take various forms depending on the experimental conditions. One can design the experiment in such a way that before measurement, the particle will either satisfy the principle of superposition or not.

An example of an experiment in which a superposition of states exists before measurement is the classic (nineteenth-century) *Young's double-slit experiment*[59]. In this experiment, individual particles (such as photons or electrons) are directed at a barrier with two slits, and an interference pattern is observed on the screen behind the barrier. This experiment illustrates the principles of interference in quantum mechanics. Before measurement, particles pass through both slits, which means they exist in a superposition of two paths. As a result, an interference pattern appears on the screen, suggesting that particles behave like waves and exist in a superposition of states, passing through both slits simultaneously.

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[59] Thomas Young, *The Bakerian Lecture, Experiments and Calculatuions relative to physical Optics* [in:] Philosophical Transactions of the Royal Society of London, Vol. 94 (1804), pp. 1-16.

An example of an experiment where there is no superposition of states before measurement is the *Stern-Gerlach experiment*[60], conducted between 1922 and 1923 by Otto Stern and Walther Gerlach at the University of Frankfurt in Germany. This experiment aimed to investigate the properties of electron spin. In this experiment, the electron is prepared in a specific spin state, for example, 'spin up' (spin ↑), which means that before measurement, the electron is precisely determined and does not exist in a superposition of states. The experiment involved directing a beam of electrons through a magnetic gradient with a specific orientation. This gradient interacts with the magnetic moment of the electron's spin. As a result of this experiment, if the electron is prepared in a state such as 'spin up,' the measurement will necessarily show that the electron also has 'spin up.' In other words, during the measurement, we always get the result 'spin up' (spin ↑) with a certainty close to 100%. In such cases where the quantum state of the electron is precisely determined before the measurement, there is no superposition. The electron's state before and after the measurement is the same.

It turns out that the way a system is prepared for an experiment, i.e., anchoring the particle in a specific spin state before measurement or the absence of such anchoring (the question of superposition), has a decisive influence on the results obtained during the measurement.

Axioeventism asserts that, *firstly*, the electron (or any subatomic particle - Object) exists in a specific quantum state before measurement (not in a superposition of states) about which the observer cannot have any information. This is an object embedded in amorphous physical reality, inaccessible to any observer. In this context, the metaphysical-positivist belief that what cannot be measured does not exist is absurd; it doesn't exist in an epistemological sense for the observer conducting experiments, but it does exist ontically as the substrate of the measured object. The object subject to measurements does not emanate from metaphysical nothingness (*ex nihilo*) or mathematical formalism. Physicists do not raise any objections regarding the existence of the object to be measured.

Secondly, during the measurement, due to the energetic disturbance of the particle by the measuring apparatus, the investigated particle assumes a different quantum state from the

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[60] David J, Griffiths, Darrell F. Schroeter, *Introduction to Quantum Mechanics*, Cambridge University Press 2018, p. 174.

initial state, which appears as the measurement result. In this way, a specific particle is identified as an element of physical reality (S-Object) accessible to the observer. However, this does not mean that only those particles that have been identified in the measurement procedure and are accessible to the observer exist as real physical reality. Measurement provides subatomic particles to the observer in the cognitive (epistemological) sense, but in no way does it create them in the ontological sense. The specific realization of the principles of *uncertainty* - the impossibility of measuring two properties of subatomic objects simultaneously and *complementarity* - the behavior (particle or wave) of subatomic particles depends on the way the experiment is designed.

Quantum entanglement is indeed a fundamental concept in quantum mechanics. It was introduced by Erwin Schrödinger to describe a situation in which two quantum objects come into direct interaction as a result of certain physical processes, and when they are separated after some time, their properties differ from what characterized them before the direct interaction. Furthermore, from theoretical considerations, it follows that '*entanglemen*t' leads to the negation of the postulates of so-called *local realism* (objectivism, the limitation of velocity, causality). Albert Einstein tried to explain the nature of 'entanglement' in accordance with local realism, suggesting the existence of hidden variables that jointly determine the states of particles before 'entanglement' and still interact with each other after separation. This idea was used in the Bohmian interpretation of quantum mechanics (BBI). However, the concept of hidden variables was challenged as a result of experiments (*Bell tests*).

It turned out that the theoretical assumptions that determine the ways experiments are conducted have a significant impact on the results. There are well-known *Aspect-Zeilinger experiments*[61] designed to confirm quantum non-locality regarding 'quantum entanglement' and thus refute the premises of local realism. In fact, results were obtained that suggest inconsistency between experiments and local realism. On the other hand, the *Zeilinger experiment*[62] (with a team) from 2007 was designed to explore whether '*quantum entanglemen*t' could be explained using hidden local variables. It turned out that the experiment did not provide

[61] Alain Aspect, Philippe Grangier, Gerard Roger, *Experimental Tests of Realistic Local Theories via Bell's Theorem*, Physical Review Letters, Vol. 47, No 7, 17 August 1981.

[62] Simon Gröblacher, Tomasz Paterek, Rainer Kaltenbaek, CaslavBrukner, Marek Żukowski, Markus Aspelmeyer, Anton Zeilinger, *An experimental test of non-local realism*, Nature (446), May 2007.

evidence that non-locality is necessary to explain 'quantum entanglement'.

In the context of the dispute between local and non-local realism, axioeventism accepts the following theses:

1. *Objectivism* - reality exists independently of any observer, measurement, or any act of perception. The Copenhagen interpretation (CI) of quantum mechanics, as well as any concepts considering the construction of the universe by the observer (such as retro-causality or reverse time), align with idealistic philosophy (in the sense of subjective idealism) and are firmly rejected by axioeventism. There is only one reality, which exists independently of the knowing subject. However, in the subatomic world, the direct object of knowledge is exclusively the *S-Object* because the *Object* is disturbed by the measuring apparatus during the act of measurement. In the macroscopic world, the *S-Object* is nothing more than an entity directly perceivable, extracted from the ontic universe.

2. Physical interactions can occur both at a finite speed (l*ocal realism*) and at an infinite speed (*non-local realis*m). There is no exclusion of the existence of particles (tachyons) moving faster than the speed of light.

3. Every event in the ontic universe, which includes the realm of physical reality in both the macroscopic world (*classical physics*) and the subatomic realm (*quantum physics),* is subject to *probabilistic determinism* (Def. 2.10). In exceptional cases, it may transition into unequivocal determinism (classical). From a temporal parameter perspective, irreversible events exist in the ontological universe to the same extent as reversible events (Def. 8.1.).

Nature of Reality.

> It is a common view among many of today's physicists that quantum mechanics provides us with no picture of 'reality' at all! The formalism of quantum mechanics, on this view, is to be taken as just that: a mathematical formalism. This formalism, as many quantum physicists would argue, tells us essentially nothing about an actual quantum reality of the world, but merely allows us to compute probabilities for alternative realities that might occur. Such quantum physicists' ontology—to the extent that they would be worried by matters of 'ontology' at all —would be the view (a): that there is simply no reality expressed in the quantum formalism. At the other extreme, there are many quantum physicists who take the (seemingly) diametrically opposite view (b): that the unitarily evolving quantum state

completely describes actual reality, with the alarming implication that practically all quantum alternatives must always continue to coexist (in superposition)[63].

At the subatomic level, reality is the collection of all possible quantum objects (*Objects* in an axiomatic sense), for example, an electron exists genuinely before measurement. *Objects* are devoid of experimental content, belonging to the '*hidden*' (implicit) reality, about which one can only say that it exists (*ontic truth* – Def. 7.2.) and serves as a substrate (***ex nihilo nihil fit***) for S-objects (e.g., an electron after measurement), appearing as the effect of measurement performed by an observer (*ontic truth*). *S-construct* is essentially a model of S-object (e.g., characteristics of an electron after measurement), providing a more or less experimentally verified characterization of the electron as such (*correspondence truth* – Def. 7.2.). In the case of RAES, the electron is an abstract-essential entity that exists independently of the knowing subject and physical reality but can be reconstructed by the knowing subject (if it exists at all) in an infinite series of approximations (*asymptotic truth* – Def. 7.2.).

On the other hand, macroscopic physical reality consists of a set of all physical objects, also encompassing three types of objects (*Object*, *S-object*, *S-construct*), according to axioeventism. It differs primarily from subatomic reality in its relationship to the knowing subject (the hypothetical observer making measurements). While there is no direct cognitive access to physical reality (*Object*) in the subatomic world, such a possibility exists in the macroscopic world. Specifically, *Object* is directly knowable (it does not exist as an unknowable, hidden reality); it is simply a fragment of physical reality extracted by the identifying principles formulated by the knowing subject into the form of *S-object.*

3.1.4. Cosmology

The foundation of contemporary cosmological models consists of three main premises: the cosmological principle, the cosmic microwave background (CMB), and the expansion of the universe.

The cosmological principle states that on a large scale, the universe is homogeneous and isotropic. This implies that on vast cosmic scales, its physical properties remain the same in every place

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[63] Roger Penrose (2004), *The Road to Reality. A Complete Guide to the Laws of the Universe*, Jonathan, p. 782.

and in every direction. In other words, no point within it stands out as special compared to all others; disregarding local irregularities, the universe looks the same from any vantage point at any given moment. This suggests that the physical laws applicable in our Solar System are uniform everywhere, and astronomical observations made on Earth can reasonably be extrapolated to the entire universe.

The cosmological principle encompasses two key components. The first is *cosmic homogeneity* - physical properties such as matter density or temperature are similar in every location. There are no distinct regions that are significantly more condensed or dispersed. The second is *cosmic isotropy* - the universe appears the same in every direction. Observed physical properties, such as the distribution of galaxies or the cosmic microwave background radiation, remain consistent regardless of the direction of observation. This indicates the absence of any preferred ontological direction in the cosmos.

The Cosmic Microwave Background (CMB) is one of the most significant discoveries in the fields of cosmology and astronomy, providing crucial insights into the evolution of the Universe. It is electromagnetic radiation in the form of microwaves, with a temperature of about 2.7 K (equivalent to -270.45 degrees Celsius), filling the cosmic space, and is a remnant of the Big Bang.

The source of CMB lies in the early Universe when it transitioned into a plasma state - a state of matter where physical entities are separated into electrons and nuclei, resulting in a state of ionized matter (particles possessing an electrical charge). Over time, the Universe cooled sufficiently for objects to combine and form neutral atoms of hydrogen and helium, marking a process known as recombination - the merging of electrons primarily with protons. This led to the emission of photons of specific energies as electrons combined with nuclei, giving rise to the background radiation (CMB). Additionally, recombination facilitated the emergence of a neutral Universe, enabling the formation of permanent cosmic structures, such as galaxies.

The discovery of this radiation occurred in the 1960s (by Arno Penzias and Robert Wilson). CMB played a significant role in advancing the concept of the Big Bang and continues to be instrumental in nearly all contemporary cosmological models. CMB provides essential information regarding the composition, history, and evolution of the Universe.

The expansion of the universe is described by two concepts: redshift and Hubble's law, which refer to different aspects of this expansion.

Redshift is a phenomenon associated with the universe's expansion, involving a change in the wavelength of radiation from astronomical objects. When an astronomical object moves away from an observer, the spectrum of its emitted light shifts towards longer wavelengths, meaning the light becomes more red. This effect, known as redshift, is a key evidence of the universe's expansion. Redshift can be measured for astronomical objects like galaxies and these measurements can be used to determine their speed of recession from the observer.

On the other hand, *Hubble's law*, formulated by Edwin Hubble in the 1920s, is a mathematical description of the relationship between the velocity of astronomical objects moving away and their distance from the observer. Hubble's law states that an object moves away from an observer at a velocity proportional to its distance; the farther the cosmic object is from the observer, the faster it moves away. Formally: $v = H_0 r$, where v is the object's velocity, r is its distance, and H_0 is the Hubble constant, determining the rate of the universe's expansion (approximately 70 km/s/megaparsec; one megaparsec is about 3.09 million light-years). This law describes the general trend of the universe's expansion, allowing for the determination of the universe's age, but unfortunately, it doesn't explain the precise mechanisms or sources of this expansion.

The issue of the origin of the Universe is one of the oldest philosophical problems, often posed in the form of whether the Universe had a beginning and, potentially, whether it will have an end in the future. In the past, it was believed that the question of *whether the world had a beginning* had only two possible answers: *yes* or *no*. Today, we think that there can be numerous answers because the question itself is not precise. Resolving the issue of the origin of the Universe depends, among other things, on adopting a specific ontological standpoint. For instance, within the framework of *theistic creationism*, there is a belief that the world had a beginning in an act of creation by God (*an absolute beginning*). In this context, the world exists because God brought it into being by the power of His will; 'created' meaning called into existence *ex nihilo*. On the other hand, an extreme realist would exclude any supernatural intervention in the world of matter and confine the search for a starting point solely to the initiation of the formation of the present state of the Universe, thus seeking an answer to the question of its *relative beginning*.

Since the emergence of Einstein's theory of relativity, particularly the general theory, cosmological models based on it began to be constructed. Among the earliest was a model developed in 1922 by the Russian physicist Alexander A. Friedmann. He based his model on the equations of Albert Einstein's general theory of relativity, assuming that space is infinite and flat (without curvature). His original model assumed the homogeneity and isotropy of the Universe, as well as its expansion or contraction over time. It was one of the initial attempts to apply the general theory of relativity to describe the cosmology and the evolving Universe.

However, as early as 1924, A. Friedmann extended his equations to a spherical space, which corresponds to positive curvature. In 1924, he developed a model describing the Universe as a closed spherical space. Ultimately, in 1927, Friedmann published works in which he included differential equations describing the dynamics of the Universe for flat space (lack *of curvature*), space with positive curvature (*spherical*), and space with negative curvature (*hyperbolic*), thus creating a more general cosmological model.

In a certain sense, Friedman became a precursor to the concept of cosmological singularities. A cosmological singularity is a state in the Universe where certain physical quantities, such as density, temperature, pressure, reach infinitely large values or become infinitely small. In the context of cosmology, a cosmological singularity would imply a situation where the parameters of the Universe become infinite, which is mathematically challenging to describe and may suggest limitations in our current knowledge or physical model. It wasn't until the discovery of the *Cosmic Microwave Background* (CMB) in the 1960s that a more adequate understanding of what was happening in the early stages of the Universe emerged without the necessity of resorting to the concept of cosmological singularities. However, the existence of specific boundary conditions that may lead to cosmological singularities is not ruled out.

Nevertheless, speculative cosmological models still exist, which *ex definitione* presuppose the existence of a cosmological singularity. Here are a few examples of such models:

Cosmic String Singularity: In some theories concerning cosmic strings, the existence of singularities called 'cosmic string singularities' is postulated. These singularities would be associated with extremely thin, dense cosmic strings that could exist in space.

However, there is a lack of experimental evidence for the existence of such singularities.

Cosmic Brane: In some cosmological theories based on superstring theory, the existence of cosmic 'branes' as singularities is suggested, in which space and time can intersect or merge with each other. Here too, there is a lack of experimental confirmation.

Cyclic or Oscillatory Theories: In some alternative cosmological theories, it is suggested that the universe is part of a cyclic or oscillatory process in which periodic singularities exist. In other words, these theories suggest that the universe goes through cycles of explosion and expansion, as well as contraction and collapse (possibly continuous oscillation), and there is no single Big Bang and a single direction of the universe's evolution. As a result of the emergence of infinite values in astrophysics equations, all known physical laws governing matter cease to apply. Therefore, we are unable to describe what happened to the universe before the moment of its expansion, before the Big Bang.

In the light of contemporary cosmology, the question of the beginning and evolution of the Universe depends on various factors, such as the choice of a reference frame, the acceptance or rejection of the thesis about the existence of universal cosmic time, or the acceptance of either statistical or deterministic characteristics of time. Presently, the question of the origin of the Universe is rather replaced by the question about the nature of the spacetime structure of the Universe. This is justified by the developmental trends in cosmology observed in the second half of the 20th century and the first decades of the 21st century. A pivotal point was the formulation of Einstein's general theory of relativity, which laid the foundation for relativistic cosmology. *Relativistic cosmology* examines the structure and evolution of the universe, assuming that space and time are curved by the presence of mass and energy, in accordance with the equations of general relativity. This theory allows describing the evolution of the universe, including its expansion, the formation of galaxies, the formation of cosmic structures, as well as understanding many cosmic phenomena, such as black holes or the *cosmic microwave background* (CMB).

Currently, selected cosmological concepts will be briefly presented in a chronological approach, which are still being developed in response to new observations and discoveries. These concepts are the following: FLRW models, the Lambda-CDM model, the Kaluza-Klein theory, supergravity theory, string theory, the inflationary model, and the multiverse.

The FLRW (Friedmann-Lemaître-Robertson-Walker) model was independently proposed by Alexander Friedmann (1922), Georges Lemaître (1927), Howard Robertson (1929), and Arthur Walker (1936). These models, developed by the respective physicists, were based on Einstein's equations and were a pivotal step in the advancement of modern cosmology.

In 1922, the Russian physicist Alexander A. Friedman constructed a cosmological model based on Einstein's equations, assuming an infinite and flat space, along with the homogeneity and isotropy of the Universe. In 1927, Georges Lemaître expanded on this concept, which in the 1940s Fred Hoyle dismissively termed the 'Big Bang' but it soon became the popular term for the cosmological theory describing the initial state of the Universe. This theory describes the state of the Universe in its very early stages of evolution, when the density and temperature were extremely high.

By the late 1930s, the American physicist Howard P. Robertson and the British mathematician Arthur Geoffrey Walker developed general solutions to Friedman's equations, considering different forms of spatial curvature (flat, spherical, hyperbolic).

The essence of the FLRW model can be presented as follows (the Big Bang concept, isotropy and homogeneity, three types of curvature and composition of the Universe):

The Big Bang Concept. There exists an initial state known as the Big Bang, marking the start of the Universe's expansion and its evolution over time. At the moment of the Big Bang, the density and temperature of the Universe were infinitely high, constituting a cosmic singularity. However, cosmological models based on the FLRW equations do not describe the Big Bang itself but rather its expansion after the singularity. The Universe then underwent expansion, gradually cooling and giving rise to cosmic structures such as galaxies and stars. Nevertheless, the nature of the Big Bang remains beyond the scope of physicists' considerations.

> The creation of the Universe out of nothing has been argued, indecisively, from early times; see for example Kant's first Antinomy of Pure Reason and comments on it (Smart (1964), pp. 117-23 and 145-59; North (1965), pp. 389-406). The results we have obtained support the idea that the universe began a finite time ago. However the actual

point of creation, the singularity, is outside the scope of presently known laws of physics[64].

Based on observations of the expansion and the content of matter and energy in the Universe, scientists can estimate the time that has passed since the Big Bang. The currently estimated age of the universe is around 13.8 billion years.

Isotropy and Homogeneity. *Isotropy* refers to the uniformity of the Universe on a large scale in all directions, exhibiting an even distribution of matter and energy in every direction. No preferences or variations in cosmic properties are observed in different observational directions. On the other hand, *homogeneity* means that the Universe looks the same on a large scale in every place, displaying a uniform distribution of matter and energy regardless of location (matter and energy density are similar everywhere in the Universe).

Three Types of Curvature. FLRW models assume that the cosmic space can have three different geometries: flat (Euclidean), spherical (positively curved), or hyperbolic (negatively curved). This allows for the analysis of various scenarios in the Universe's development.

Composition of the Universe. FLRW models take into account ordinary matter (baryonic matter), which is subject to its respective interactions (gravitational, electromagnetic, weak, and strong forces), as well as all other types of radiation, such as thermal, cosmic, or cosmic background radiation a remnant from the Big Bang).

The Lambda-CDM (Lambda Cold Dark Matter[65]) model roughly encapsulates its essence. It consists of two elements: Lambda - representing the cosmological constant, symbolizing the mysterious, as yet unknown, dark energy; Cold Dark Matter - representing similarly mysterious, cold, dark matter. Essentially, this model expands on the FLRW model. It is based on the same assumptions: the Big Bang (the explosion of hot and dense matter resulting in the expansion of the hot Universe), isotropy (equality in every direction), and homogeneity (uniformity at every point in space). It also considers three types of curvature (spherical, flat, and hyperbolic) and the composition of the Universe (in the Lambda-CDM model, expanded to include dark energy and dark matter).

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64 Stephen W. Hawking & G.F. Ellis (1973), *The large scale structure of space-time*, Cambridge University Press, p. 364.

65 The Lambda-CDM model is often referred to as the standard model, with the earlier use of this term reserved for the FLRW model.

The development of the Lambda-CDM model progressed in stages, combining appropriate theoretical concepts and empirical observations.

1. In 1917, A. Einstein introduced the concept of the cosmological constant (Lambda, Λ) into his equations to achieve a solution that would allow for the existence of a static Universe. At that time, the Universe was considered steady, unchanging, and static, and Lambda was treated as a kind of 'antigravity' in Einstein's equations to balance the effect of gravitational attraction of matter. However, after Edwin Hubble's discovery in the 1920s that the Universe was expanding, Einstein considered the addition of the cosmological constant Lambda a mistake and removed it from his equations, labeling it as the ‘biggest blunder of his career’.

In the 1990s, observations indicating the accelerating expansion of the Universe suggested the existence of a factor countering gravity, prompting a return to the concept of the cosmological constant, Lambda. In the Lambda-CDM model, it represents the mysterious *'dark energy'* (a hypothetical form of energy with non-zero density) responsible for the accelerated expansion of the Universe. *Lambda* is used as a symbol representing the density of cosmic energy, purportedly constituting about 68% of the Universe's composition. This energy is considered constant throughout cosmic space and does not change over time.

> Curiously, the term ‘cosmological constant’ seems to have gone out of fashion almost as soon as Λ was observationally discovered, despite that being the standard terminology since Einstein’s theoretical introduction of it in 1917. Instead, Λ is referred to as ‘dark energy’, or ‘vacuum energy’, or sometimes ‘quintessence’, perhaps because the cold term ‘cosmological constant’ does not carry with it a sufficient air of mystery, or perhaps, a little more rationally, because the presence of the word ‘constant’ rather implies that Λ cannot change with time! Many cosmologists seem to be happier with a varying Λ, possibly regarding the present ‘Λ’ as representing the onset of a ‘new inflationary phase’, where they point out the similarity to the supposed very early inflationary phase of the universe[66].

Before, back in the 1930s, Swiss scientist Fritz Zwicky observed significant discrepancies between the mass calculated based on the

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[66] Roger Penrose (2004) *The Road to Reality, A Complete Guide to the Laws of the Universe,* Jonathan Cape, p. 772.

motion of galaxies in clusters and the mass calculated from observed light. He added a significant amount of 'dark matter' (an invisible form of matter that doesn't interact electromagnetically and doesn't emit light) to the equations for calculating cluster mass. This 'dark matter' exerts a gravitational influence on visible, ordinary matter (baryonic matter). Meanwhile, in the 1970s, American astronomer Vera Rubin studied the rotation of spiral galaxies and discovered that stars in galaxies were rotating too quickly considering the mass observed in the form of starlight. This suggested the presence of a substantial amount of 'dark matter' around these galaxies, influencing the dynamics of their rotation. This addition of 'dark matter' to the Lambda-CDM model, alongside 'dark energy', was a result of these observations.

2. In 1965, Arno Penzias and Robert Wilson discovered the cosmic microwave background (CMB), confirming the Big Bang theory and suggesting the dynamic evolution of the Universe.

3. In 1980, Alan Guth proposed the concept of cosmic inflation, suggesting that the very early Universe underwent a brief period of rapid expansion, which would account for observable properties such as isotropy, homogeneity, and the uniform scattering of the CMB. This concept soon became an important element of the Lambda-CDM model.

4. In the 1980s and 1990s, the work of researchers like Stephen Hawking and George Ellis contributed to a better understanding of cosmic processes analyzed within the framework of the Lambda-CDM model.

S. Hawking, in 1974, proposed a theory showing that black holes aren't entirely 'black' but emit heat, now known as Hawking radiation. This discovery was a significant step toward understanding the connection between gravity and quantum mechanics. While this finding pertained to black holes rather than the direct evolution of the Universe, it impacted the general comprehension of gravity in extreme conditions, which is significant in the context of the Lambda-CDM model.

G. Ellis in the 1970s worked on the theory of cosmic perturbations. This theory deals with fluctuations in matter density in the Universe and how these fluctuations transform into structures such as galaxies and clusters of galaxies. His work on the theory of perturbations was crucial in understanding how cosmic structures evolve within the framework of the Lambda-CDM model.

The Lambda-CDM model is currently a widely accepted cosmological model that excellently describes many cosmic observations, such as the distribution of cosmic structures (like galaxies) or the origin of cosmic microwave background radiation. It's a pivotal model that researchers use to analyze and expand our understanding of the Universe. However, this doesn't mean that work on other cosmic models has been abandoned.

The Kaluza-Klein theory was introduced in the 1920s by German physicist Theodor Kaluza and Swedish physicist Oskar Klein. It involved extending the general theory of relativity by introducing an additional dimension to spacetime, representing one of the early attempts to unify gravity with Maxwell's electrodynamics. A 'hidden' fifth spatial dimension was introduced into the gravitational equations, where the electromagnetic field, the carrier of light, was interpreted as a result of the curvature of this fifth dimension.

Thus, the curvature of the fifth dimension was closely related to the electromagnetic field (light moving along this curvature in the fifth dimension). This inventive approach aimed to unify the gravitational and electromagnetic fields into a single framework. However, the Kaluza-Klein theory was abandoned in the 1930s for two reasons: *firstly*, the rise of a new revolutionary theory in physics - quantum mechanics; and *secondly*, the hypothesis of the fifth dimension proved impossible to even approximately verify empirically. Although the Kaluza-Klein theory resurged in the 1960s, after unsuccessful attempts at renormalization[67] (eliminating infinities in equations), it was quickly abandoned once again.

Theory of supergravity. The development of supergravity theory began in the 1970s, largely due to the work of Julius Wess and Bruno Zumino. A significant feature of this theory is the incorporation of the principles of supersymmetry (SUSY) in describing gravity. SUSY in the realm of elementary particle theory introduced a new symmetry between fermions (particles with half-integer spin) and bosons (particles with integer spin). It aimed to address certain issues such as the mass hierarchy problem, which concerns the difference in masses between the Higgs bosons and other particles.

> In 1971, Bunji Sakita of the City College of New York and JeanLoup Gervais of the École Normale in Paris found a partial answer to this puzzle. They showed that the Neveu-

[67] The American physicist R. Feynman developed the method of renormalization, a technique for redefining certain infinite quantities appearing in equations in such a way that they cancel out (+ ∞ - ∞ = 0). In 1965, along with Schwinger and Tomonaga, he was awarded the Nobel Prize for their work on removing infinities in quantum field theory.

> Schwarz-Ramond theory indeed possessed a hidden symmetry that was responsible for its astonishing properties. These pioneering discoveries marked the beginning of supersymmetry. (Supersymmetry was proposed simultaneously by two Soviet physicists, Yu. A. Gol'fand and E.P. Likhtman, although their work was not appreciated in the West at that time.)
> The supersymmetry Gervais and Sakita discovered was the most unusual symmetry ever found. For the first time, a symmetry was created that could rotate a bosonic object into a fermionic object. Eventually, this meant that all bosonic particles in the universe had a fermionic partner[68].

In supergravity theory, supersymmetry is merged with gravity. The graviton, the carrier particle of gravitational force in the realm of general relativity, and a boson with a spin of 2, has a supersymmetric partner, the supergraviton, which is a fermion with a spin of 3/2. These additional supersymmetric particles expand the characteristics of the gravitational field, incorporating them into the formalism of the general theory of elementary particle interactions.

There exist numerous variants of supergravity, such as N = 1, N = 2, N = 3, etc., differing in the level of supersymmetry and complexity. For instance, N = 1 supergravity refers to a theory with the minimal amount of supersymmetry, whereas N = 8 supergravity is more intricate and has more degrees of freedom.

However, it's worth emphasizing that supergravity theory remains an area of intense scientific research, and experimentally confirming its aspects still presents a significant challenge.

Theory of strings. String theory's development began in the 1960s, with key contributions from scientists such as Leonard Susskind, Holger Bech Nielsen, Leonard Brink, and others.

It gradually evolved into an extensive branch of theoretical physics aiming to describe the fundamental structures and principles governing the universe at the level of elementary particles. The central idea of this theory involves replacing traditional point-like particles, such as electrons or quarks, with infinitely thin and elastic 'strings'. Variances in the properties of elementary particles, such as mass or charge, arise from differences in the vibrational modes of these strings. Different modes of vibration correspond to different particles. Notably, a string's oscillation frequency depends on its

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[68] Michio Kaku and Jennifer Thompson (1997), *Beyond Einstein. The Cosmic Quest For The Theory of The Universe,* Oxford University Press, p. 115.

interaction with other strings, so no so-called elementary particle can be attributed greater or lesser fundamental significance.

In string theory, there's a concept that the universe might possess more than three spatial dimensions. Furthermore, the theory maintains that the Big Bang isn't a primary event in the evolution of the Universe but rather an outcome of a ten-dimensional universe splitting into two parts.

> According to superstrings, the universe originally existed in ten dimensions, not the four dimensions (three space dimensions and one time dimension) of today. However, because the universe was unstable in ten dimensions, it cracked into two pieces, with a small, four-dimensional universe peeling off from the rest of the universe. (…)
> If this theory is true, it means that our universe actually has a sister universe that coexists with our universe. It also means that the original fissioning of our universe was so violent that it created the explosion that we know as the Big Bang. The superstring theory, therefore, explains the Big Bang as a by-product of a much more violent transition, the cracking of the ten-dimensional universe into two pieces[69].

String theory postulates the existence of additional, hidden dimensions that are too small to be observed in our everyday reality. One of the main objectives of string theory is to unify all four fundamental physical forces: gravity, electromagnetism, strong, and weak interactions. Currently, string theory focuses on attempting to merge quantum gravity with the theory of elementary particles.

An extension of string theory is the theory of superstrings. It differs from conventional string theory by two postulates. The first involves introducing supersymmetry (SUSY), and the second involves the introduction of heterotic strings:

> The heterotic string consists of a closed string that has two types of vibrations, clockwise and counterclockwise , which are treated differently. The clockwise vibrations live in a ten-dimensional space. The counterclockwise live in a 26-dimensional space, of which 16 dimensions have been compactified. (We recall that in Kaluza's original five-dimensional theory, the fifth dimension was compactified by being wrapped up into a circle.) The heterotic string owes its name to the fact that the clockwise and the counterclockwise vibrations live in two different

[69] Ibidem, p. 12.

> dimensions but are combined to produce a single superstring theory. That is why it is named after the Greek word for heterosis, which means "hybrid vigor."[70]

Due to the inclusion within the framework of superstring theory, SUSY allows for greater uniformity in describing fundamental interactions, unifying electromagnetic, weak, strong, and gravitational forces into a coherent formalism. Moreover, superstring theory postulates the existence of two hyper-spaces, one containing ten dimensions, and the other a staggering twenty-six. These dimensions are chosen because only within them can strings vibrate in a quantum-coherent manner. The issue of the beginning of our Universe (in terms of Einstein's spacetime) must therefore be relativized to a ten-dimensional hyper-space, which, under boundary conditions, can *tunnel* to a twenty-six-dimensional hyper-space. Our spacetime Universe thus turns out to be just one among many possible Universes; the concept of its beginning loses even physical meaning.

The inflationary model, proposed in the 1980s by physicist Alan Guth, suggests that in the early stages of the Universe, around 10^{-36} to 10^{-32} seconds after the Big Bang (the so-called inflationary epoch), there was a rapid and brief expansion of cosmic space. In this context, '*inflation*' refers simply to a '*sudden expansion'* that occurred very shortly after the Big Bang. The sudden expansion (inflation) resolves issues (encountered by other models) regarding the fact that certain areas of the Universe, which had no opportunity for information exchange, exhibit similar properties.

This primarily addresses the following problems related to observed characteristics of the Universe: isotropy, homogeneity, structural diversity, and the horizon problem. Before the emergence of the inflationary model, it was difficult to satisfactorily explain the fact why regions of the Universe, even millions of light-years apart, displayed similar physical properties (such as temperature or chemical composition).

Isotropy of the Universe. As a result of the sudden expansion of space (inflation), the areas of the Universe that were inherently in contact with each other before inflation and characterized by a uniform distribution of physical properties retained this pre-inflation uniformity afterward.

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[70] Michio Kaku (1994), *Hyperspace A Scientific Odyssey Through Parallel Universes, Time Warps, and The Tenth Dimension*, Oxford University Press, p. 158.

Homogeneity of the Universe. The rapid expansion of the Universe (inflation) immediately after the Big Bang did not disrupt the even distribution of matter and energy. This uniform distribution persists regardless of the time elapsed since the Big Bang.

Structural diversity of the Universe. Non-inflationary cosmological models faced significant challenges in explaining the diversity of the Universe's structure—such as star systems, galaxies, or galaxy clusters. The inflationary model defines the initial conditions for the formation of diverse structures. Specifically, small quantum fluctuations that emerged during inflation evolved under the influence of gravity, giving rise to diverse cosmic structures.

Horizon Problem of the Universe. The universe's horizon represents the furthest extent observable to us. It limits what we can see and where information available to an observer at any given time may originate. In other words, it's the maximum distance light can have traveled from the beginning of the Universe to a specific moment. The issue of the Universe's horizon can be encapsulated in the question: why do areas of the Universe, unable to interact due to the limitations of light speed (lacking sufficient time for information exchange), nevertheless exhibit similar physical properties, such as temperature or chemical composition.

> The main idea behind inflation is that in the early universe there is a short time when the universe expanded very fast, usually an exponential expansion. If the inflationary period is long enough, it would flatten the universe quickly (solving the flatness problem), it would also explain why some regions could be in causal contact with each other, solving the horizon problem. Finally the fast expansion would dilute many objects, such as monopoles and other unwanted massive particles in such a way as to make them harmless for the over-closure of the universe[71].

Under standard conditions, if we were to look at region A and region B, sufficiently distant from each other (considering the speed of light), there wouldn't be a reason to presume that they should exhibit similar properties since they had no chance for mutual interaction. However, cosmic observations show that different areas of the Universe are quite homogeneous and isotropic. Assuming these characteristics can reasonably be extrapolated beyond the

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[71] Fernando Quevedo, *Lecture on String/Brane Cosmology*, Theory Division, CERN CH-1211 Geneva 23, Switzerland, p. 12. https://arxiv.org/pdf/hep-th/0210292.pdf

Universe's horizon, the question arises: how is this possible if light had no time to travel from region A to region B?

According to the inflationary model, prior to inflation, the entire Universe was densely condensed into a single 'point.' In the very early stages of development, even before inflation, the physical properties of regions slightly separated from each other were similar because all these regions shared common initial conditions, being part of one densely condensed 'point.' Inflation occurred shortly after the Big Bang, introducing a rapid expansion of space.

> In the inflationary scenario, in the first trillionth of a trillionth of a second, a mysterious antigravity force caused the universe to expand much faster than originally thought. The inflationary period was unimaginably explosive, with the universe expanding much faster than the speed of light. (This does not violate Einstein's dictum that nothing can travel faster than light, because it is empty space that is expanding. For material objects, the light barrier cannot be broken.) Within a fraction of a second, the universe expanded by an unimaginable factor of 10^{50}.[72].

The inflationary expansion caused regions that were previously physically connected to suddenly become significantly distant from each other. However, they still retained fundamental similarities in their properties because they shared common initial conditions even before inflation emerged. Therefore, similarities between regions A and B are possible even when they're beyond the range of mutual interaction due to the limitations of the speed of light.

Presently, the inflation model is combined with the Lambda-CDM model, which describes the evolving universe, accounting for dark matter and dark energy, mathematically associated with the cosmological constant Λ.

Multiverse. The concept within cosmology known as the multiverse suggests the existence of numerous parallel universes differing from ours in fundamental properties such as physical constants, natural laws, or the configuration of space-time. These are separate realities coexisting simultaneously, acting as independent types of universes. Each of them may possess distinct physical laws, history, or configuration. The multiverse concept is generally presented in the context of various physical theories and

[72] Michio Kaku (2005), *Parallel Worlds A Journey Through Creation, Higher Dimensions, and the Future of the Cosmos*, Published by Doubleday, p. 13.

cosmological models. Let's briefly outline three variants of the multiverse: the many-worlds interpretation (MWI), Multiverse in String Theory, and Multiverse in the Inflationary Model.

The Many-Worlds Interpretation (MWI). This concept was proposed by Hugh Everett in 1957 concerning the interpretation of quantum mechanics. His work, published under the title '*Relative State Formulation of Quantum Mechanics*' presents an interpretation of quantum mechanics suggesting that every quantum measurement is realized in all of its potential outcomes, with each outcome existing in a separate universe. In other words, each quantum event causes the branching of reality, creating parallel worlds with different quantum states.

An attempt was made to transfer this idea to a cosmological level. However, directly translating it to the cosmic scale, to the level of the universe as a whole, is challenging and has not yielded satisfactory results in this context. Primarily because MWI in quantum mechanics pertains to very small scales, at the level of elementary particles, while cosmology deals with the macroscopic structure of the universe and its evolution over time. The regularities occurring within small-scale structures are significantly different from those observed within large-scale structures.

Multiverse in String Theory. String theory suggests that the universe might be far more complex than what we perceive in our daily reality. Its fundamental entities are strings, which can stretch, rotate, and vibrate in various ways, creating different particles that interact with each other. Unlike the point-like objects in traditional particle physics, strings have some extension. In string theory, to mathematically describe the behaviour of particles and their mutual interactions coherently, space-time must possess more than the three spatial dimensions and one temporal dimension we observe. These additional dimensions are hidden, imperceptible at a macroscopic scale. Except the *strings* (fundamental objects, at least in some variants), there are *branes* - multi-dimensional spatial structures along which strings move.

In the concept of the multiverse within string theory, there are several variants or models indicating the possibility of multiple parallel universes, each potentially having its distinct fundamental physical properties. The most prominent concepts are those that locate the multiverse within 'strings' or within 'branes'. According to the *first*, it's assumed that strings (or superstrings) can have different configurations, leading to the formation of branched structures in space, creating separate universes. In other words, the way strings are arranged or vibrate could generate different universes. In accordance with the *second* concept, various universes might reside on different branes. Each universe would exist on a distinct brane and would be characterized by specific physical properties.

In string theory, there's a suggestion that beyond the existing three spatial dimensions and one temporal dimension in our universe, there exist additional hidden dimensions arranged in a way that renders them invisible to observers within our universe. The concept of a *hyperspace* relates precisely to these additional hidden dimensions. Their existence may lead to the formation of various spatial structures, or universes, each with its distinct physical properties.

In the 1990s, *M-theory* was proposed as an extension of string theory. However, it's not a fully developed and complete concept but rather a collection of ideas that hold the potential to unify different variants of string theory. Its complete development and mathematical formulation remain a challenge for physicists.

> String theory and M-theory are based on the simple and elegant idea that the bewildering variety of subatomic particles making up the universe are similar to the notes that one can play on a violin string, or on a membrane such as a drum head. (These are no ordinary strings and membranes; they exist in ten- and eleven-dimensional hyperspace.)[73]

M-theory stands for ‘*membranes and branes theory*’. This conceptual framework extends the ideas of string theory by proposing the existence of membranes (suggests a two-dimensional) or ‘branes’ (suggests objects of different dimensions), as fundamental concepts in M-theory. The ‘M’ in M-theory doesn't have an universally agreed-upon definition; some suggest it stands for ‘membrane’, ‘matrix. ‘master’ or ‘mystery’.

Multiverse in the Inflationary Model. The multiverse concept within the framework of the inflationary model in cosmology postulates the existence of an infinite number of universes, each representing different regions of the cosmos. According to this concept, the process of inflation (the rapid expansion of the universe) in the very early stages of the universe's existence led to the formation of so-called *'cosmic bubbles'*. The emergence of these new '*bubbles*' in the expanding cosmos might result from the non-uniformities and fluctuations present in the initial inflationary space. These fluctuations give rise to the formation of distinct, separated areas, or universes, each with their own sets of physical constants

[73] Ibidem, p. 17.

and specific configurations of particles. Consequently, these universes operate under their own unique laws of nature, distinct from the laws governing other universes.

> According to this theory, a tiny patch of a universe may suddenly inflate and "bud," sprouting a "daughter" universe or "baby" universe, which may in turn bud another baby universe, with this bud-ding process continuing forever. Imagine blowing soap bubbles into the air. If we blow hard enough, we see that some of the soap bubbles split in half and generate new soap bubbles. In the same way, universes may be continually giving birth to new universes. In this scenario, big bangs have been happening continually. If true, we may live in a sea of such universes, like a bubble floating in an ocean of other bubbles. In fact, a better word than "universe" would be "multiverse" or "megaverse"[74]

It's worth emphasizing that ideas regarding the multiverse are speculative and remain purely theoretical. Currently, there are no direct pieces of evidence for the existence of other universes beyond our own. When discussing the multiverse, it refers to areas of the cosmos that are presently beyond the possibilities of observation and verification. In this scenario, the multiverse remains just one of the areas of research that scientists explore to better understand the nature of reality.

In summary, various theories and models in cosmology and theoretical physics are interconnected because they all explore different aspects of the universe and seek to understand its fundamental properties. While they may be applied in different contexts, their collective goal is to expand our knowledge of the nature of the universe.

3.2. Psychic Reality

In a broad simplification, it can be said that three main concepts dominate in psychology: behaviorism, psychodynamics, and cognitive.

Behaviorist concept. This concept primarily focuses on the study of observable behaviours and reactions, as well as the role of the external environment in shaping these behaviours and reactions.

[74] Ibidem, p. 14.

> Behaviorism is a psychological theory of human development that posits that humans can be trained, or conditioned, to respond in specific ways to specific stimuli and that given the correct stimuli, personalities and behaviors of individuals, and even entire civilizations, can be codified and controlled[75].

Key figures in the emergence and development of behaviorism included, among others, John B. Watson (1878-1958), B.F. Skinner (1904-1990), and Ivan Pavlov (1849-1936). Among the important tenets of behaviorism, the following can be listed:

Focus on Observable Behaviours - behaviourists assume that the only things that can be scientifically studied are external, measurable behaviors. They concentrate on what is visible and measurable, excluding elements such as thoughts, feelings, or psychological processes that are not directly observable.

Conditioning - behaviourists believe that behaviour is a result of learning through experience. The two main types of learning they emphasize are classical conditioning (Ivan Pavlov) and operant conditioning (B.F. Skinner).

Classical conditioning is a learning process based on the association between a natural stimulus and a conditioned stimulus, leading to the development of a behavioural response. In other words, the conditioned stimulus (originally neutral) is presented simultaneously with the unconditioned stimulus (triggering a natural response) to establish a connection. As a result of this association, the conditioned stimulus begins to evoke a response that is similar or identical to the response elicited by the unconditioned stimulus.

Instrumental conditioning focuses on the relationship between behaviour and its consequences, assuming that people learn through the consequences of their actions. Skinner believed that the consequences of behaviour influence whether a particular behavior will be repeated or not. Skinner introduced the concepts of reinforcement and punishment as key elements of instrumental conditioning. Reinforcement is a process in which positive consequences of behaviour make its repetition more likely. On the other hand, punishment is a process in which negative consequences make the repetition of behaviour less likely.

Analysis of basic behaviours - behaviourism focuses on simple and precisely defined analyses of behaviours that can be measured

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[75] *The Gale Encyclopedia of Psychology* (2001), Bonnie Stricland, Executive Editor, p. 72.

and recorded. The aim is to identify cause-and-effect relationships between stimuli and responses (stimulus – response).

Psychodynamic concept. This concept, developed mainly by Sigmund Freud, is based on the assumption that there are hidden forces and processes in the mind that influence an individual's behaviour:

> Freud believed that human personality was constructed of three parts: the id, the ego, and the superego. The id, according to this schema, is comprised largely of instinctual drives - for food and sex, for instance. These drives are essentially unconscious and result in satisfaction when they are fulfilled and frustration and anxiety when they are thwarted. The ego is linked to the id, but is the component that has undergone socialization and which recognizes that instant gratification of the id urges is not always possible. The superego acts in many ways like the ego, as a moderator of behavior; but whereas the ego moderates urges based on social constraints, the superego operates as an arbiter of right and wrong. It moderates the id's urges based on a moral code.[76]

The psychodynamic concept focuses on the role of unconscious psychological processes, internal conflicts, and the dynamics of emotions in shaping the behaviour and psychological functioning of an individual. In addition to Freud, this concept was further developed by figures such as Carl Jung, who introduced the notion of the collective unconscious (elements shared by people on a cultural level) and archetypes (universal symbols appearing in various cultures), and Alfred Adler, who concentrated on the role of self-worth (the individual's actions are often motivated by a desire to overcome their 'inferiority complex').

Cognitive Concept. This concept focuses on the study of cognitive processes, which are the ways individuals process, interpret, and remember information, make decisions, and solve problems. The cognitive approach also concentrates on how the collection of information obtained from the environment influences human behaviour:

> An approach to psychology which focuses on the relationship between cognitive or mental processes and

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[76] Ibidem, p. 516.

> behavior. The cognitive psychologist studies human perceptions and the ways in which cognitive processes operate developed a theory of cognitive growth. His theories, which approached development from a different angle than - and mostly complement - those of Piaget, focus on the environmental and experiential factors influencing each individual ‘s specific development pattern[77].

Research on language, communication, and thinking is a key area within the cognitive concept. Psychologists are interested in how people acquire language, how they use it in communication, and also how language influences the thought process itself. The cognitive concept assumes the existence of schemas, concepts, or conceptual representations that aid in organizing information and facilitate its processing. This is aimed at optimally influencing the development of the human individual.

3.3. Social Reality

In the history of social thought, three distinct perspectives on the essence of society continue to clash to this day: *organic*, *individualis*tic, and *realistic*. Each of these perspectives interprets the relationship between the individual and society differently, placing emphasis on the interplay between individual well-being and the common good in unique ways.

Organicist Concept (*Plato*, *Aristotle*, *Spencer*, *Hegel*) - society constitutes a substantial entity, a unified whole similar to a biological organism; the individual, in turn, is a part of this whole (society takes precedence over the individual). According to this perspective, the human individual, in and of itself, has no inherent goals but serves specific functions within the entirety. The meaning of one's existence and actions is realized only when fulfilling functions within the societal framework, and only to the extent that these functions are fulfilled. As per this approach, the individual does not possess personal rights but only those granted by society. The organicist understanding of the essence of society often led to totalitarian solutions regarding the relationship between the individual and the collective. The individual is expected to act unconditionally for the *collectivity good* and completely submit to the laws imposed by the collective (state, nation, political party).

[77] Ibidem, pp. 133-134.

Individualistic Concept (Mechanistic, Nominalistic, Atomistic, Social Contract Theories[78]) - society is viewed as a simple aggregation of individuals (the individual takes precedence over society).

The epistemological foundations for this theory were laid in antiquity by thinkers such as Anaxagoras and Democritus, asserting that only individual things truly exist, while wholes constructed from them are merely products of the human mind (ontological nominalism). This ontological theory was adapted for ethical purposes, notably by Epicureans who argued that happiness consists of experiencing individual pleasure since there is no other. In modern times, ontological nominalism formed the basis of the social contract theories of Hobbes, Locke, and Rousseau - the existence of society depends on a contract in which individuals agree to transfer some of their individual rights to the collective.

According to individualistic theory, the so-called *common good* is the sum of the goods of the greatest number of individuals, and there is no separate entity called the common good that is distinct from the goods of individual entities. Society is entirely subservient to the individual; the role of society primarily involves removing obstacles that hinder individuals from achieving their private goods to the greatest extent possible.

Realistic Concept (Functional) - society is a complex of various relationships that connect individuals within a given community (the individual and society condition each other mutually). According to this concept, there exists a *community good* distinct from the sum of individual goods. The joining of individuals into specific collectives occurs precisely to achieve this common good. However, the amalgamation requires the establishment of an appropriate collective authority to enforce the actions of individuals for the benefit of the whole. This results in the creation of a qualitatively distinct entity and, simultaneously, a spiritual social bond. The community good (the goal of the group's actions) differs both quantitatively and qualitatively from the individual good of each person. On one hand, individual goods are subordinate to the public good, and individuals have a duty to act for the community good. On the other hand, individuals have rights within the group to pursue their individual goods through the community good.

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[78] The diversity of names for this theory arises from different ways of justifying it or from variations in the analysis of the common good.

The matter of the relationship between individual good and the community good is not straightforward. It is not clear whether, for instance, the actions of individuals are intentionally directed towards the realization of the common good or whether it is sufficient for the effects of individual actions to contribute to the common good. This issue was addressed by the English thinker *Bernard Mandeville* (1670-1733), the author of the provocative *The Fable of the Bees* In this work, Mandeville presented the story of a beehive whose wealth, knowledge, and splendid culture impressed other insects residing in neighbouring hives.

A closer examination of the behaviours prevailing in this hive, however, brought horror. The community of the wealthiest bees, situated at the highest cultural level, was consumed by corruption and widespread deceit. Thus, lawyers prolonged legal proceedings indefinitely to continue collecting fees, doctors induced illnesses in patients to later exploit them financially, and officials, in turn, plundered everyone without exception. Nevertheless, this hive, by the standard of living, towered above all the others. So, Mandeville posed the question – could there be a positive correlation between prosperity and corruption and widespread deceit, and he provided an affirmative answer.

One day, the all-powerful Jupiter listened to the complaints of the bee people about the dishonesty of the authorities and brought about perfect virtue in the hive. The effects were not long in coming. Thousands of officials became unnecessary; lawyers and police officers lost their jobs because no one was litigating, and everyone adhered to the laws, eliminating the need for legal proceedings. Day by day, the number of unemployed increased; while the hive became very moral, it simultaneously sank into a life of poverty.

The conclusions drawn from Mandeville's fable were absolutely unacceptable to his contemporaries. He was prosecuted for spreading subversive ideas, and the book was sentenced to oblivion.

Sociologism of Emile Durkheim (1858-1917). Durkheim is the creator of the concept of sociological realism, according to which society constitutes a distinct, *sui generis* higher-order reality. Individuals forming specific social organisms behave differently than they would in isolation. The consciousness of individuals is generally considered false consciousness. There is also often a disparity between the intentions of individuals and the consequences of their intentions.

In the theory of social development, Durkheim poses two fundamental questions. The first question concerns social cohesion:

what forces and factors maintain the internal coherence of society? In response to this, he refers to the concept of solidarity: mechanical and organic. *Mechanical solidarity* implies submission to collective will (tradition and public opinion), while *organic solidarity* arises from the need for mutual services. The *second* question pertains to the factors responsible for changes in society. Durkheim identifies them in the increasing division of labour (due to the growth of social density) and the rise of specialization. Progress, according to him, is measured by the happiness of society.

According to Durkheim, human beings exhibit a particular duality (the concept of homo duplex), always finding expression in philosophical systems - *matter-body,* religious beliefs - *body-soul*, moral aspects - *egoism-altruism*, psychological realms - *senses-thinking*. On one pole are the dispositions associated with the physical needs of the body, and on the other, everything that is universal, shared with other people. On one hand, it defines humans as everything animalistic, and on the other, what characterizes only humans. There is a constant antagonism between these two poles; for instance, to act morally, a person must continuously restrain their animal nature. If one wants to conceptualize the world in general terms, they must set aside the potentially misleading testimony of the senses. *Sociological realism* provides explanations - adopting the hypothesis that beyond the individual, society exists as a real, external entity, not nominal or abstract but a system of active forces.

An expression of the existence of such a social entity is, among other things, *religion*, synonymous with all belief systems and practices that are obligatory and sanctioned within a given social group. Religion, according to Durkheim, is not traditionally understood as a belief in God or supernatural forces. The fundamental function of religion, in Durkheim's belief, is to regulate the relationship between humans and sacred things, which are personifications of society itself: in the divine - he says - I see only society, transformed and symbolically represented. Furthermore, he lists secondary functions of religion: 1) initiating the individual into collective life through religious rituals (in Catholicism - communion, confirmation); 2) bonding the community, a means of social group integration; 3) cultivating group traditions, linking the present to the past; 4) sustaining the individual in moments of breakdown and crises (the so-called *euphoric function*, reflecting the proverb: '*in times of trouble, turn to God'*).

Another manifestation of the existence of the social entity as a distinct reality is *morality*; moral norms and imperatives are exclusively products of collective consciousness. Society as a whole determines what is moral and immoral in the behaviour of individuals. Kant postulated the existence of God as a necessary condition for morality; without the hypothesis of God's existence, morality (absolute) would be entirely incomprehensible. For Durkheim, the necessary and sufficient condition for morality is society.

In the context of analyzing social reality, it would be advisable to delve into the phenomena of morality and religion.

Morality

There are many different meanings of the word 'morality,' much like the term 'ethics.' These meanings largely depend on the manner in which phenomena labelled as 'moral' or 'ethical' are contemplated within various philosophical currents, directions, or schools of thought. The concept of moral phenomena can be understood, for example, as a particular aspect of human behaviour that determines adherence to a set of fundamental values approved by a specific community or simply the general behaviours that realize such a set. Terms describing the constituents alternatively comprising the scope of morality are quite common, and within such characterizations, we find ourselves.

Thus, by morality, we will understand, firstly, everything that constitutes the social layer, i.e., a set of specific norms, evaluations, and patterns of conduct functioning in a given society. Secondly, we will understand everything that makes up the individual layer, determined each time by the individual moral agent, i.e., the motives (intentions) of an action, the fulfilment of the action, and the consequences of that action for the individual actor and their social and natural environment.

In contrast to some philosophers, we make a clear distinction between two concepts: 'morality' and 'ethics.' Morality is the subject of study in the science called ethics; it constitutes an element of social (as well as psychological) reality. Ethics, on the other hand, can be broadly defined as a branch of philosophy encompassing all issues related to the analysis of the nature of good and evil. It includes the following branches: descriptive-explanatory ethics, normative ethics, and metaethics:

> There does not seem to be much reason to think that a single definition of morality will be applicable to all moral discussions. One reason for this is that “morality” seems to be used in two distinct broad senses: a descriptive sense and

> a normative sense. More particularly, the term "morality" can be used either
> 1. descriptively to refer to certain codes of conduct put forward by a society or a group (such as a religion), or accepted by an individual for her own behavior, or
> 2. normatively to refer to a code of conduct that, given specified conditions, would be put forward by all rational people[79].

Descriptive-explanatory ethics, sometimes referred to as ethology, engages in research within the scope of the history of morality and ethics, moral psychology, and moral sociology. *Normative ethics* (moral theory), on the other hand, seeks to construct internally consistent systems of moral duties (or at least endeavours to do so), formulates conditions for the application of moral judgments, and establishes rules for justifying norms, for example, by appealing to a catalog of basic values or by indicating the consequences of actions performed in accordance with these norms. Metaethics, or the theory, deals with the logical and methodological problems of ethics:

> ethics (Gk., ethos, character) The study of the concepts involved in practical reasoning: good, right, duty, obligation, virtue, freedom, rationality, choice. Also the second-order study of the objectivity, subjectivity, relativism, or scepticism that may attend claims made in these terms[80].

Divisions within normative ethics. Discussions traditionally classified under normative ethics have a long history and are highly developed. Therefore, it is challenging to organize them by introducing a classification that meets formal correctness requirements. This is especially true since within the same system of normative ethics, various mutually complementary theoretical solutions exist, often contradicting each other. Bearing this in mind, the division of normative ethics will be made according to various classificatory criteria (Table 3.2.) and without strict adherence to the formal condition of classification, such as the exclusivity of the members of the division (thus, one can advocate both eudaimonism and perfectionism at the same time):

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[79] Bernard Gert, *The Definition of Morality*, Stanford Encyclopedia of Philosophy, https://plato-stanford-edu.translate.goog/entries/morality-efinition/?_x_tr_sl=auto&_x_tr_tl=en&_x_tr_hl=en

[80] Simon Blackburn (1996), *The Oxford Dictionary of Philosophy*, Oxford University Press, p. 127.

Criterion	**Type**	**Name of Ethics**
Summum Bonum Summum Bonum	Happiness, virtue, perfection, human dignity, pleasure, utility, laws of nature, duty, God	Eudaimonism, aretism (moralizm), perfectionism, personalism, hedonism, utilitarianism, ethics of natural law, deontology, theonomy
Cognitive Faculties	Reason, emotions, intuition, revelation	Rationalism, emotionalism, intuitionism, theologism
Reference	Individual good, the good of others	Egoistic ethics, altruistic ethics
Sources of Moral Norms	Individual, society or transcendence	Autonomous ethics, heteronomous ethics

Table 3.2. Division of Ethics

Criterion of Summum bonum. 1. *Eudaimonism* - the highest good is the achievement of happiness by an individual. Ethical positions of this kind vary significantly depending on how the concept of happiness is understood. 2. *Aretism (Moralism)* - virtue, understood in various ways, is considered the highest value. 3. *Perfectionism* - recognizes human excellence as the highest value, a desirable goal of conscious human activity. 4. *Personalism* - distinguishes the category of person in terms of its dignity as the highest ethical value. 5. *Hedonism* - sensory or spiritual pleasure is considered the summum bonum. 6. *Utilitarianism* - identifies ethical value with utility and qualifies moral judgments based on the value of the consequences of actions. 7. *Ethics of Natural Law* - ethical values are those goods that have their foundation, rooted in the rational nature of humans. 8. *Deontology* - only actions performed out of duty are ethically valuable; if the motive for an action is, for example, natural inclinations, then it lacks a moral character. 9. *Theonomism* - identifies the highest value with the pursuit of transcendence; moral norms derive their obligatory power from a supernatural authority.

Criterion of Cognitive Faculties. 1. *Rationalism* - the knowledge of ethical values is possible only through reason. 2. *Emotionalism* - emotions constitute the cognitive faculty that allows reaching ethical values. 3. *Intuitionism* - intuition as direct insight, bypassing the senses and reason, is capable of grasping ethical values. 4. *Theologism* - revelation contained in holy scriptures is the most appropriate way to acquaint oneself with ethical values.

Criterion of Reference. 1. *Egoistic Ethics* - oriented toward promoting one's own good. 2. *Altruistic Ethics* - oriented toward promoting the good of other people. Sacrificing for a specific person is called allocentrism, and sacrificing for a social group is called sociocentrism.

Criterion of Sources of Moral Norms. 1. *Autonomous Ethics* - morality is generated by the human individual. 2. *Heteronomous Ethics* - morality is imposed on the individual by society or transcendence (e.g., God).

Issues in Metaethics. The concept of metaethics may arouse some theoretical concerns, and therefore, the issues falling under this name will be signalled first. A common view is that the main problems in metaethics revolve around questions concerning the meaning of ethical terms, truth in ethics, and ways of justifying ethical statements. However, metaethicists also direct their interests toward considerations about the nature of norms and moral judgments, their sources, and the kinds of functions that individual ethical systems attribute to them.

It should be noted immediately that resolutions in the field of metaethics are not straightforward; various schools have emerged within its domain, giving rise to a specific classification of normative ethics that reflects a metaethical perspective. These include *cognitive schools* - ascribing logical value to ethical judgments (naturalism, intuitionism) - and *non-cognitive schools* - considering ethical judgments as pseudo-judgments devoid of the value of truth or falsity in logic (emotivism, prescriptivism).

1. *Metaethical naturalism* asserts that ethical terms and statements should be understood as descriptive, pertaining to certain 'natural features,' which are accessible to investigation through natural and/or social sciences. Since ethical terms denote certain empirical features, it logically follows that there is a legitimate possibility of translating ethical judgments into corresponding empirical judgments, and consequently, affirming the truth or falsity of these judgments. In this situation, the methodological status of normative ethics does not deviate from that of empirical sciences. It remains to inquire about the empirical significance that naturalists attribute to ethical terms. The answer is straightforward and, according to naturalists, depends on what is meant by the term 'morally good' in a given normative ethics—whether it denotes ‘pleasant for the individual’, ‘desirable

based on reflection', 'approved by an impartial observer' or something else.

2. *Metaethical intuitionism* denies the claim that the features signified by ethical terms can be reduced to purely natural features. Instead, these features are specifically moral and possess an autonomous ontological status. Intuitionist G.E. Moore (1873-1958) accuses moral philosophers of committing the so-called naturalistic fallacy, which involves identifying the meaning of ethical terms with the meaning of empirical terms:

> But if he confuses 'good,' which is not in the same sense a natural object, with any natural object whatever, then there is a reason for calling that a naturalistic fallacy; its being made with regard to 'good' marks it as something quite specific, and this specific mistake deserves a name because it is so common. As for the reasons why good is not to be considered a natural object, they may be reserved for discussion in another place[81].

The source of this error is most often the mistaken assumption by naturalists that certain empirical features, whether genuinely or supposedly consistently coexisting with ethical features, are indeed synonymous with the latter. The confusion of different categories of features is indicated by the so-called 'open-question argument'. We can sensibly ask whether the *definiens* fully captures the meaning of the *definiendum*; if naturalistic definitions were correct, such a question would be meaningless. Let's assume that the term 'good' means the same as 'pleasant.' However, without contradicting and in accordance with the rules of language use, we can still ask whether what is pleasant is good. If the meaning of the term 'pleasant' fully overlapped with the meaning of the term 'good,' then the term 'pleasant' could be replaced with the term 'good,' and the question would take the form: does the term 'good' mean the same as the term 'good,' which is a nonsensical question.

3. *Metaethical emotivism* emerged as a response to the criticism of naturalism by intuitionists and developed in both radical and moderate versions. In its *radical version*, it asserts that ethical terms merely express the speaker's emotions (expressive function) and influence the listener's emotions by eliciting specific feelings in them (*evocative function*). Consequently, they do not describe anything, as ethical terms have no referents. All ethical disputes are deemed illusory, as it is impossible to put forward substantive, rational

[81] George Edward Moore (1922), *Principia Ethica*, Cambridge At The University Press, 12.

arguments in favour of one position or another. This is because ethical terms lack any real-world counterparts. In the *moderate version*, emotivism allows for the existence of both emotional meaning (*expressive* and *evocative*) and descriptive, referential meaning for ethical terms. In ethical disputes, there is room for rational argumentation and justification of ethical beliefs. To this end, so-called supporting reasons are employed, which can be any statements, as long as they have the desired impact on the interlocutor, appropriately modifying their stance.

4. *Metaethical prescriptivism* regards ethical judgments as imperatives, commands – '*x is good*' means '*x ought to be chosen and realized*'. The essence of ethical disputes then boils down to the justification of issuing by normative entities inconsistent imperatives, internally contradictory, for example, norm *x* commands something that is prohibited by norm *y* within the same ethical system. The fundamental difference between ethical judgments and simple commands lies in the degree of generality, as the former possess a universal value, while the latter are relativized to the situations in which they are uttered.

Religion

Religion constitutes an immensely complex yet crucial social phenomenon. The study of religion, known as religious studies, dissects this complexity according to various criteria. For instance, there is a distinction between natural religions and revealed (founded) religions. *Revealed religions* are believed to be personally conveyed to humans by God (e.g., Yahweh, Jesus, Buddha). On the other hand, *natural religions* cannot claim divine origin (e.g., astral, solar, lunar, chthonic religions). Another classification involves monotheistic and polytheistic religions; in this case, the criterion for division is the number of recognized deities.

Given the fact of the diverse forms and manifestations of religion, defining it is not an easy task. Many scholars of religious studies attempt to answer the question of what is common in this diversity. Religion is generally considered as a belief in deities and a set of related behaviours. The understanding above characterizes religion through the relationship between humans and some external reality, namely the transcendent reality. However, this approach may seem somewhat narrow since one can sensibly speak of religion even where the transcendent is not clearly delineated. Therefore, it is better to define religion in the context of the human relationship to any objects that one categorizes as part of the realm of the sacred, i.e., *the sacred*. We can thus say that the essence of religion lies in a certain attitude of humans towards the sacred, an attitude full of reverence. The concept of reverence encompasses humility, devotion, and honour, i.e., certain psychological experiences towards something accepted as existing, worthy of approval, and desire.

Religion is a multifaceted phenomenon, engaging various spheres of human existence. Religious studies distinguish various constituent elements of religion, which typically include elements forming the *objective layer of religion*: *doctrine* (such as theology and theogony, cosmogony, anthropogenesis, or eschatology), *worship* (for example, rituals, liturgy), and *organization* (mystery societies, church). Doctrine, whose original form is called myth, constitutes the theoretical foundation of religious beliefs. The practical expression of doctrine includes ritual activities such as prayer, sacrifices, ablutions (ritual washings), pilgrimages, or processions. Components of the *subjective layer of religio*n, constituting religious faith, also belong to the constituent elements of religion. These involve specific experiences of reverential contemplation (imbued with respect) towards the sacred, which is directed towards a particular object, ideal, or a set of real or ideal objects recognized by believers as sacred. Therefore, religion can be understood as a certain referential relationship between the profane and the sacred, with the caveat that the profane sphere includes, among other things, individual human beings or social groups. Religious value, on the other hand, is something different; it belongs to the realm of subjective values (faith):

> **Def. 3.1.** ***Religious valu*e (faith) is a contemplation of reverential (imbued with respect) nature towards a certain conscious subject regarding any sacred entity, coupled with a supplicatory attitude aimed at assistance in worldly life, and the entire set of practices serving this purpose.**

Religion, therefore, is a field of personal experience and social life whose meaning boils down to the reverential contemplation of humans towards the sacred and specific practices serving this purpose. The term '*sacred*' was introduced into religious studies by R. Otto (1869-1937) and popularized by the Romanian historian of religion M. Eliade (1907-1986). According to Eliade, religion is an ahistorical structure, independent of any socio-economic conditions, and sacredness (the sacred) is its elementary factor that gives meaning to all phenomena in the world and, significantly, is part of the set of elementary needs of humans.

In the concept of the founder of the French school of sociology, Emile Durkheim (1858-1917), there is an opposition between the sacred and the profane, where the *sacred* denotes the sphere of sacred phenomena created by society, fundamentally important for humans, while the *profane* represents the natural order based on the individual experiences of individuals, the sphere of everyday phenomena.

In the '*reverential*' concept of religion, the concept of the sacred is similar to Durkheim's but not synonymous. Here, it denotes any supernatural order constituted by the sphere of spirituality, including spiritual force (*animatism*), impersonal spirit (a*nimism*), and personal spirit (*theism*). In opposition to the *sacred*, which is the sphere of spirituality, the spiritual, there is the *profane,* which encompasses all material, social, and individual phenomena manifested in ordinary, everyday experience.

Tasks of doctrinal nature in nearly every religion, appropriately advanced in terms of theoretical foundations, involve resolving the issue of the relationship between the sacred and the profane in various dimensions. However, detailed resolutions usually derive from the fundamental question concerning the genesis that takes place between the sacred and the profane; the question revolves around what originates from what and how.

The history of religions points to the existence in religious thought of the belief in the primacy of the sacred over the profane in the order of existence. It also indicates the existence of at least four types of genesis of the profane sphere from the sacred: *creation*, *emanation*, *modality*, and *transformation* (Table 3.3.)

Positions	**Genesis**	**Example**
Supernaturalism	Creationist	Judaism, Christianity
	Emanative	Zoroastrianism
Pantheizm	Modality	Hinduism
	Emanative	Neoplatonism
Naturalism	Transformational	Mesopotamian belifs

Table 3.3. Genesis of the Profane from the Sacred

Creation - in a religious context, primarily within Christianity, it signifies the act of creating the world out of nothing (*creatio ex nihilo*). However, it can also be associated with a concept that assumes the continuous creation of the world by the sacred (creatio continua) or sustaining it in existence (*conservatio mundi*). It is usually linked to the position known as supernaturalism, acknowledging the existence of a supernatural world fundamentally different from the natural order experienced through the senses.

Emanation - the process of emanating from the sacred, where a being qualitatively distinct from the sacred and usually identified with the material world is separated. Intermediate degrees are permissible.

Moduality - the sacred and the profane are considered as certain *modes*, ways of existence of the One. Both the sacred and the profane manifest in everything that exists; spirituality is just a manifestation, one side of the One or its aspect, while the other side is constituted by matter. The emanative and modulatory type of relationship between the sacred and the profane is reflected in the position called *pantheism* (everything is God), according to which divinity, considered as the active principle, identifies with nature.

Transformation - the processing of the passive element (matter) by the active element (spirituality) within the original One. It is somewhat related to *ontological naturalism*, a perspective recognizing nature itself as the reason for its existence and thereby rejecting the belief in the existence of any transcendent being, i.e., external to nature.

3.4. Reality of Abstract-Essential Structures

In the introduction to this chapter, we will focus on three contemporary concepts that explicitly discuss certain abstract-essential entities. These concepts belong to *Alfred North Whitehead* (1861-1947), *Karl Raimund Popper* (1902-1994), and *Roger Penrose* (1931-).

Alfred N. Whitehead's Concept. The most significant work of A.N. Whitehead is 'Process and Reality' (1929). In it, he maintains that process is a fundamental aspect of reality. In contrast to substantial ontologies that focus on enduring entities, Whitehead acknowledges that what exists are various kinds of processes (sequences of change). He introduces a distinction between events and entities – aggregates of events, which, while more enduring and stable than events, nonetheless, like events, constitute the constitutive elements of processes. Whitehead emphasizes creativity as a crucial element of reality. Processes are capable of spontaneous creativity, and reality is open to novelties and transformations.

In Chapter III (The Categories of Existence), Whitehead presents the categories of existence he has developed (various classes of beings) that make up processes, including the existence of ideas:

> There are eight Categories of Existence:
> (i) Actual Entities (also termed Actual Occasions), or Final Realities, or Res Verae.
> (ii) Prehensions, or Concrete Facts of Relatedness.
> (iii) Nexus (plural of Nexus), or Public Matters of Fact.
> (iv) Subjective Forms, or Private Matters of Fact.
> (v) Eternal Objects, or Pure Potentials for the Specific Determination of Fact, or Forms of Definiteness.
> (vi) Propositions, or Matters of Fact in Potential [33] Determination, or Impure Potentials for the Specific Determination of Matters of Fact, or Theories.
> (vii) Multiplicities, or Pure Disjunctions of Diverse Entities.
> (viii) Contrasts, or Modes of Synthesis of Entities in one Prehension, or Patterned Entities[82].

Category V is *eternal objects or pure potentials*. Eternal objects are abstract, enduring, and unchanging patterns that constitute the potential ground for specific events and entities (aggregates of events) in the process of reality. They are ideas that exist independently of specific entities and can be understood as absolute beings because they are enduring and immutable over time. However, they are not entirely separate from processes but are an integral part of what Whitehead calls the '*related universe*.' Ontologically, *eternal objects* are somewhat similar to Plato's Forms, as they are enduring and unchanging.

Karl R. Popper's Concept. According to Popper, there are three distinct (autonomous) worlds. The *first* is the world of objects and physical states, existing independently of human perception. The *second* is the world of mental states (thoughts, ideas, or beliefs) and behavioural dispositions; this world exists only in human minds. Finally, the *third* is the world of objective content of thought, which exists independently of our thoughts; it results from the socio-cultural activities of humans. This world includes theoretical systems, problems and problem situations, scientific and literary

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[82] Alfred North Whitehead (1978), *Process And Reality. An Essay In Cosmology*, The Free Press, p. 22.

works, as well as all the contents of traditional libraries and computer memories, etc.

Thought in the subjective sense is nothing other than the state of mind of a specific human individual, while thought in the objective sense is knowledge formulated linguistically and thus accessible to everyone. Moreover, only thought in the objective sense can be the subject of rational discussion. The first world (physical) interacts mutually with the second world (subjective thought), and the second world interacts mutually with the third world (objective thought). However, the first and third worlds do not interact directly with each other but only through the intermediary of the second world. Despite being a product of human activity, the third world remains fully autonomous.

However, it should be noted at this point that the ontological status of the *third world* appears rather enigmatic:

> Thus what I call 'the third world' has admittedly much in common with Plato's theory of forms or ideas, and therefore also with Hegel's objective spirit, though my theory differs radically, in some decisive respects, from Plato's and Hegel's. It has more in common still with Bolzano's theory of a universe of propositions in themselves and of truths in themselves, though it differs from Bolzano also. My third world resembles most closely the universe of Frege's objective contents of thought[83].

One can, however, consider that Popper's conception of the *third world* is one of many responses to the question of the existence and status of abstract entities. Yet, is Popper's proposed solution regarding abstract entities in any way more satisfying than the speculations of other philosophers? We read in "*Epistemology Without a Knowing Subject*:"

> Among the inmates of my 'third world' are, more especially, theoretical systems; but just as important inmates are problems and problem situations. And I will argue that the most important inmates of this world are critical arguments, and what may be called - in analogy to a physical state or to a state of consciousness - the state of a discussion or the state of a critical argument; and, of course, the contents of journals, books and libraries. (…)

[83] Karl R. Popper (1972), *Epistemology Without a Knowing Subject* [in:] *Objective Knowledge: An Evolutionary Approach*, Oxford University Press., p. 333.

> We can thus say that there is a kind of Platonic (or Bolzanoesque) third world of books in themselves, theories in themselves, problems in themselves, problem situations in themselves, arguments in themselves, and so on. And 1 assert that even though this third world is a human product, there are many theories in themselves and arguments in themselves and problem situations in themselves which have never been produced or understood and may never be produced or understood by men[84].

According to Popper, traditional epistemology, both from the Enlightenment era (e.g. J. Locke, D. Hume) and contemporary times (e.g., B. Russell), focused on the analysis of subjective, individual, or potentially intersubjective mental experiences. In other words, it investigated knowledge in the subjective sense (conscious states and dispositions for specific actions). Therefore, it exclusively belonged to the *second world*. On the other hand, the *third world*—the world of the contents of consciousness - is radically different. On one hand, it possesses the value of *autonomy*, and on the other hand, its characteristic is o*bjectivity*. Furthermore, it completely does not depend on whether someone knows and understands the theories, justifications, and problem situations that constitute it. Contents of consciousness are knowledge (a set of information) without a knowing subject, as long as, of course, they are formulated in some language.

However, Popper's concept of the *third world* has its weaknesses. The notions of autonomy and objectivity are not clearly defined. It is also uncertain whether the demand for consistency within the theories contained in the *third world* is fulfilled. After all, scientific knowledge is known to abound with conflicting theories. In that case, is there room in Popper's *third world* for all theories along with their consequences, or only for certain ones? If it is only for certain ones, criteria for selecting theories should be identified. Furthermore, the status of theories and metatheories in the *third world* is not clear, and there may be resulting paradoxes. Consequently, the question arises: what would be their impact on the overall knowledge contained in it?

Richard Penrose's Concept. One of the central elements in R. Penrose's book '*The Emperor's New Mind*' is the concept of three worlds: the *world of the mind* (consciousness), the *physical world* (physical objects), and the *Platonic world* (abstractions). While the

[84] Ibidem pp. 334, 342.

existence of the first two is evident, the existence of the world of abstractions should be marked with a question mark:

> How 'real' are the objects of the mathematician's world? From one point of view it seems that there can be nothing real about them at all. Mathematical objects are just concepts; they are the mental idealizations that mathematicians make, often stimulated by the appearance and seeming order of aspects of the world about us, but mental idealizations nevertheless. Can they be other than mere arbitrary constructions of the human mind? At the same time there often does appear to be some profound reality about these mathematical concepts, going quite beyond the mental deliberations of any particular mathematician. It is as though human thought is, instead, being guided towards some external truth- a truth which has a reality of its own, and which is revealed only partially to any one of us[85].

1. *The world of the mind* (consciousness) is the mental realm that encompasses our thoughts, conscious experiences, feelings, and intentions. It is a subjective sphere, rather difficult to reduce to simple physical processes.
2. *The physical world* is the material realm that includes physical objects, their properties, and spatial relations. It is a world that we can perceive through our senses, and its functioning is described by the laws of physics.
3. *The world of abstractions* is the domain where mathematical objects and abstract structures exist independently of any connection to human consciousness. They are not products of human thinking, particularly not a mental construct or a human-created abstraction. Penrose argues that mathematical objects exist independently of human thought, and mathematicians merely discover them rather than construct them.

The problem of universals. The issue of the existence of abstract-essential reality has been a topic considered throughout the history of philosophy as the problem of universals. Generally, universals refer to general objects and concepts that apply to many individual instances. Put less precisely, universals are general, abstract-essential counterparts of any individual objects.

[85] Roger Penrose (1989), T*he Emperor's New Mind*, Chap. 3. *Mathematics and Reality*, Oxford University Press.

The philosophical dispute over *universals* essentially began with *Socrates*. Defending the idea of the absolute nature of right and wrong actions, he attacked the sophists' doctrine that every individual, as a specific entity, is the measure of their own truth and, consequently, their own good. Therefore, it is futile to speak of absolute truth and absolute good. Socrates, on the contrary, believed that justice, righteousness, and virtue exist in and of themselves, independently of what one or another considers to be just, righteous, or virtuous. The concepts of justice, righteousness, and virtue exist genuinely in the minds of all people and can be captured in the form of definitions (achieved through the application of the *elenctic* or *maieutic* method[86]), to which all people agree, regardless of the place and times in which they live.

Plato adopted Socrates' concept of universals, initially applied in the realm of ethical general concepts, and extended it to the entire reality; he made universals the ultimate foundation of individual entities. *Universals* are nothing but objective ideas possessing their own being, distinct and independent of both the objects in which they manifest and the minds that conceive them. Using another term, we can say that they are general concepts possessing self-existent being (*extreme conceptual realism*).

Plato's view was attacked by the *Cynics* and *Cyrenaics*, who asserted that *universals* are merely emerging impressions of similarity in the human mind, occurring between individual entities. There is, therefore, nothing like real counterparts of general concepts, nothing that exists outside our minds as self-existent and distinct entities. Moreover, being aware that we do not directly know the sensory impressions and thoughts of other people, we can never be certain if everyone perceives the same impressions of similarity. In other words, we cannot be sure if so-called *universals* are indeed universals, as the process of establishing them is fraught with uncertainty.

Aristotle also criticized Plato's view, but in a different way than the Cynics and Cyrenaics. Universals cannot exist in themselves as distinct substantial entities because only what is individual possesses substantial being. They also cannot be impressions of similarity residing in human minds because what is general and universal must somehow be connected to individual entities. The only reasonable

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[86] The *elenctic* method involves asking cunning questions aimed at leading the interlocutor into contradictions with themselves and, thereby, to admit their own ignorance. On the other hand, the *maieutic* method entails skilfully posing questions in a way that allows the interlocutor to independently arrive at correct answers.

solution, therefore, is to recognize that universals are an integral part of individual being, determining their membership in a set of objects of the same kind or type; thus, a *universal* is essentially a shaping *form* for material substance. Every individual being necessarily belongs to some kind or type, and what qualifies these beings for kinds or types is the possession of a common universal form. Therefore, one can say that, in Aristotle's understanding, a universal is a general element (*form*) co-constituting, along with the individual element (*matter*), individual substantial entities (*moderate conceptual realism*).

The *medieval period* was particularly interested in the problem of universals. Inspiration for the dispute over the status of general entities was drawn, among other sources, from the writings of *Porphyry of Tyre* (c. 234–c. 305), a student of Plotinus, as found in his work *Isagoge*:

> (2) For example, I shall beg off saying anything about (a) whether genera and species are real or are situated in bare thoughts alone, (b) whether as real they are bodies or incorporeals, and (c) whether they are separated or in sensibles and have their reality in connection wit them. Such business is profound, and requires another, greater investigation[87].

During the medieval period, four positions emerged in the discussion regarding the problem of universals: extreme realism, moderate realism, nominalism, and conceptualism.

1. *Extreme Realism* (William of Champeaux, John Scotus Eriugena, Anselm of Canterbury) - the referents of general names exist outside the realm of individual objects as a self-existent reality. Thus, according to extreme realism, there exists humanity as such, embodying the ideal manifestation of characteristics that are only to some extent present in specific individuals.

2. *Moderate Realism* (Albert the Great, Thomas Aquinas) - the referents of general names are within the realm of individual objects as their essential properties. Concrete things contain so-called constitutive features that determine their essence (*quidditas*).

3. *Nominalism* (Roscelin of Compiegne) - only general names exist, serving as mere abbreviations for individual names; general names do not have any real extralinguistic counterparts. Universals

[87] Porphyry the Phoenician, *Isagoge*, https://homepages.uc.edu/~martinj/History_of_Logic/Problem_of_Universals/Porphyry%20Isagoge%20English%20(Spade).pdf

exist as the sound of the voice (*flatus vocis*) representing similar aspects and features of concrete individual things.

4. *Conceptualism* (Pierre Abelard) - the referents of general names exist and are located in the human mind as certain mental entities. Abelard observed that a name is not just a sound (*vox*) but a sound with a certain meaning (s*ermo*). It is through this meaning that a name acquires the quality of generality, as within one word are encapsulated designations for any number of individual objects. The mind, based on general names, constructs mental entities that contain representations of all the common features of a set of concrete individual things.

In contemporary times, the debate over universals primarily occurs within the realms of philosophy of logic and mathematics, revolving around the question of whether there are sets in the distributive sense[88], and if they do, what kind of existence this is. Modern counterparts to medieval positions include: Platonism, neo-nominalism and neo-conceptualism.

Platonism - for every one-place condition, there exists a set of all and only those objects that satisfy that condition. This set is distinct from its elements and, moreover, exists in the same way as its elements.

Neo-nominalism - the use of sentences about sets is merely a shorthand way of expressing oneself. This is because each such sentence can be reduced to a sentence about individuals.

Neo-conceptualism - a set exists only when it can be constructed from sets that have already been constructed or whose existence can be discovered through direct intuition. The previous opposition of existence outside the mind - existence in the mind has been replaced by the opposition of *constructing* - *discovering*.

Axioeventistic Approach

The Reality of Abstract-Essential Structures (RAES) comprises the following structures (Table 3.4.): mathematical objects, scientific idealizations, and universals (positive or negative):

Reality of	Mathematics Objects

[88] A set in the *distributive* (set-theoretical) sense is a whole composed of certain objects connected by a common feature. Meanwhile, a set in the *collective* sense is a whole composed of certain objects, treated as parts of that whole.

<table>
<tr><td rowspan="3">Abstract-
Essential
Structures</td><td colspan="2">Scientific Idealizations</td></tr>
<tr><td rowspan="2">Universals</td><td>Positive</td></tr>
<tr><td>Negative</td></tr>
</table>

Table 3.4. The Reality of Abstract-Essential Structures (RAES)

Mathematical Objects - these are entities (such as groups, rings, metric spaces) determined solely by their relations and properties, typically defined within specific sets of axioms (for example, real numbers are defined by the axioms of differential and integral calculus). The properties of these objects are expressed in a universal manner, meaning that they apply to all objects satisfying certain conditions, regardless of their specific nature or representation. Moreover, abstract mathematical structures (objects) are entirely independent of concrete physical realities. As a result, they can be applied in various fields of science, technology, and other disciplines without the need to conform to specific physical details.

Scientific Idealizations - these are certain abstract, simplified models representing specific portions of the Ontic Universe, and as such, they enable a more precise or more useful analysis of that portion. Idealizations of this kind are common in the natural sciences (but also in other disciplines, such as economics - the model of a rational decision-maker), especially in physics.

One of the well-known idealizations in physics is the model of a *perfect black body* - an abstract idealized object that completely absorbs all incident electromagnetic radiation across all wavelengths. Simultaneously, according to Stefan-Boltzmann's law, a perfect black body emits electromagnetic radiation proportional to the fourth power of its absolute temperature. While absorption and emission are related, it does not imply that the perfect black body retains all radiation. On the contrary, it radiates with an intensity proportional to its temperature. This idealization assists in describing the thermal radiation of bodies based on their temperature.

Examples of other idealizations in physics include the following: *Perfectly rigid body* - does not undergo deformation under the influence of external forces. *Ideal gas* - molecules are point particles, do not interact with each other, and their motion is entirely random. *Point source of light* - radiation emanates from a point with negligible volume. Each of these idealizations simplifies the description of certain physical phenomena, allowing for more tractable mathematical models and analysis.

Universals - these are abstract structures of any kind, semantically serving as counterparts to general names, and, along with mathematical objects and scientific idealizations, belong to the Reality of Abstract Structures (RAES). This position is traditionally referred to as extreme conceptual realism (Platonism in the traditional sense). In particular, the category of universals includes all types of so-called *Teleological Abstracts* (Table 7.9.), meaning fundamental ideas in the Platonic sense (*Platonic Trinit*y), as well as constitutive features of the individual and social collectivity, defining the essence of humanity.

If any abstracts are not nothingness, and indeed mathematical objects, scientific idealizations, or equivalents of general concepts certainly are not nothingness, then they must possess a certain kind of existence[89].

> **<u>Def. 3.2.</u> *The Reality of Abstract-Essential Structures* (RAES) comprises mathematical objects, scientific idealizations, and universals, and is characterized by the following properties: atemporality, aspatiality, staticity, self-existence, and passive potentiality.**

The *Reality of Abstract-Essential Structures* (RAES) is characterized by certain properties that, due to its abstract nature, possess the quality of necessity. These properties include the following: atemporality, aspatiality, staticity, self-existence and passive potentiality:

*Atemporalit*y – abstract-essential structures, by their essence, are not in any way tied to the parameter of time. The proper term for this condition is precisely ‘atemporality’ rather than ‘eternity’ as the latter implies some connection with time.

Aspatiality – abstract-essential structures, by their nature, are not associated with physical space. However, the term ‘abstract space’ can be meaningfully used.

Staticity – abstract-essential structures are static; they do not undergo any changes or evolution.

Self-existence - abstract-essential structures exist on their own, independent in any way from anything else. Being atemporal, they

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89 *The world of literary fiction* is of a particular kind, which is also not nothingness and thus possesses a certain kind of existence. Clearly, it is not an existence in the spatiotemporal or abstract-essential sense as in RAES. It is to be assumed that the world of literary fiction alternatively belongs to psychic reality or social reality.

lack both origin and purpose. Aspatial and static, they are not subject to specific changes and do not constitute elements in any sequence of changes.

Passive potentiality - abstract-essential structures represent passive potentials (devoid of initiating force on their own), which can actualize in a dynamic, temporal, and spatial Ontic Universe (OU). This is precisely what underlies the mathematical nature of the inanimate nature or the evolution of the living nature within the scope of Ontic Universe. Nature actualizes within itself certain abstract-essential structures among the infinitely many structures of the Reality of Abstract-Essential Structures (RAES).

The mathematical nature of the natural world refers to the observable tendency in nature to 'utilize' mathematics as a fundamental tool for describing and understanding various phenomena. This concept suggests that mathematical laws are somehow embedded in the structure and functioning of nature, enabling us to describe and predict its diverse aspects through mathematics. For example, Lotka-Volterra equations describe population dynamics in ecology, and Maxwell's equations describe the behaviour of electromagnetic fields

In the context of living nature, let's consider an example provided by Aristotle. The seed of a plant has the potential to become a full-grown plant. Processes such as germination, growth, and photosynthesis actualize this potential, transforming it into an actual plant. Therefore, the seed has a certain potentiality that is realized through the processes of growth.

Let us emphasize, however, that what is common to both types of reality: the Ontic Universe (OU) and the Reality of Abstract-Essential Structures (RAES) is *temporal infinity*. Both types of reality (with some limitation regarding the Ontic Universe) are not temporally constrained in any way. While the Reality of Abstract Structures is timeless (the category of time is meaningless in reference to it), the Ontic Universe is immersed in the stream (past-present-future) of infinite time (see: Chapter 8). In other words, it persists eternally, having neither a beginning nor an end. Of course, the assertion of temporal infinity constitutes a certain ontic assumption (of a metaphysical nature) that cannot be confirmed or refuted in any way.

4. Indeterminacy and Determinacy in Axioeventism

Types of entropy

In a general sense, the concept of ‘entropy’ is associated with uncertainty, variously understood as chaos, disorder, or dispersion. The term ‘entropy’ derived from the Greek language (*en* - in, *trope* - turn), was introduced in thermodynamics (the science of heat transformations and their relationship to mechanical motion) in 1865 by the German physicist R.E. Clausius (1822-1888):

> If we wish to designate S by a proper name we can say of it that it is the t*ransformation content* of the body, in the same way that we say of the quantity U that it is the *beat and work content* of the body. However, since I think it is better to take the names of such quantities as these, which are important for science, from the ancient languages, so that they can be introduced without change into all the modern languages, I propose to name the magnitude S the *entropy* of the body, from the Greek word *η ιρπη,* a transformation. I have intentionally formed the word *entropy* so as to be as similar as possible to the word *energy*, since both these quantities, which are to be known by these names, are so nearly related to each other in their physical significance that a certain similarity in their names seemed to me advantageous[90].

Below, we will briefly consider the following types of entropy: thermodynamic, statistical, informational, and quantum.

Thermodynamic entropy - is associated with the second law of thermodynamics, which, in a colloquial formulation, states that in any thermodynamic process, it is not possible to convert all supplied heat into mechanical work without simultaneous interaction with the surroundings or reducing the overall usefulness of energy in the system. In other words, certain thermodynamic processes are irreversible and unidirectional. It is not feasible to transform all supplied heat into mechanical work without losses, and each thermodynamic process leads to an increase in the entropy of the system or its surroundings.

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[90] Rudolf E. Claussius (1963), *The Second Law of Thermodynamic* [in:] W. F. Magie, *A Source Book in Physics*, Harvard University Press, Cambridge, Massachusetts, p. 234.

Thermodynamic entropy serves as a measure of disorder or chaos in a system. The essence of the second law of thermodynamics is the assertion that the tendency for entropy to increase is natural in thermodynamic processes. Thermodynamic processes always occur in the direction of increasing entropy. A more precise formulation can be found in the work of R. Feynman [*Table 44-1. Summary of the laws of thermodynamics*].

First law: Heat put into a system + Work done on a system = Increase in internal energy of the system: $dQ + dW = dU.$ *Second law*: A process whose only net result is to take heat from a reservoir and convert it to work is impossible. No heat engine taking heat Q1 from T1 and delivering heat Q2 at T2 can do more work than a reversible engine, for which $W = Q1 - Q2 = Q1 = Q1 = \left(\frac{T_1 - T_2}{T_2} \right)$ *The entropy of a system is defined this way*: (a) If heat ΔQ is added reversibly to a system at temperature T, the increase in entropy of the system is $\Delta S = \Delta Q/T$. (b) At $T = 0$, $S = 0$ (third law). In a *reversible change*, the total entropy of all parts of the system (including reservoirs) does not change. In *irreversible change*, the total entropy of the system always increases[91].

Table 4.1. Summary of the laws of thermodynamics

Statistical entropy. The universe, in a naturalistic understanding, comprises matter and energy, and furthermore, it is characterized by order and chaos. While the existence of the former elements has never been seriously questioned, the issue of order and chaos has generated a series of controversies regarding their ontological status and their role in the structure and dynamics of the universe.

It has been observed that the amount of chaos contained in a system is proportional to its size. This relationship between the

[91] *The Feynman Lectures on Physics* (2010), Feynman, Leighton, Sands, Vol. I, Basic Lecture, Table 44-1.

amount of chaos and the size of the system is referred to as the *postulate of chaos proportionality*. Based on combinatorial calculus, the following formula has been established for calculating the arrangement of atoms in any space, given the values of *r* (radius) and *n* (number of atoms): $N = \frac{r^r}{n^n (r-n)^{(r-n)}}$. However, attempting to define the measure of chaos in a system by considering the number *N* of arrangements of arbitrary elements based on the radius *r* fails because it violates the *postulate of chaos proportionality*. It has been found that the number of arrangements of elements N in a certain space cannot serve as a measure of chaos.

It was the Austrian physicist L. Boltzmann (1844-1906) who noticed that taking the logarithm of the term leads to an expression that takes into account the postulate of chaos proportionality. For this reason, it was accepted that not *N* (the number of arrangements) but the *logarithm of N* becomes the basis for defining a quantity intended to serve as a measure of the amount of chaos contained in a given system. This quantity is called statistical entropy and is expressed by the formula:

$$S = k \ln N$$

where:
S – entropy,
k - Boltzmann constant, approximately equal to 1.38×10^{-23} J/K (joules per Kelvin),
ln – natural logarithm with the base e = 2.71828, indicating that this formula describes entropy in natural units (nats) or Neper units, where k takes a value of *1*,
N – the number of arrangements or states of a given system.

The measure of the amount of chaos can also be expressed by the formula:

$$S = k \log_2 N$$

where the logarithm with base 2 is used, corresponding to units of binary information (bits).

In both cases, the above formulas are used in statistical physics (as well as information theory) to describe the degree of disorder in a given system. Both of these formulas can be considered equivalent; they differ only in the units in which entropy is measured. Hence, the entropy values resulting from the application of both formulas will differ from each other.

Entropy has been interpreted as a measure of the disorder of microscopic material objects (*statistical entropy*). For instance, the thermal energy of particles can be concentrated either in small volumes or large ones; temperature is a measure of this concentration. When particles are concentrated in a small area, the temperature is high, and if the particles are dispersed, the temperature decreases as a result. Macroscopic material objects with uneven temperatures, by necessity according to observed regularities, transfer thermal energy to each other until reaching a state of temperature equilibrium. The state of thermal equilibrium between these objects, in accordance with the principles of thermodynamics, is the most probable state.

L. Boltzmann also linked entropy to the concept of probability by introducing the following function for the thermodynamic state, known as *Boltzmann's entropy equation*:

$$S = k \ln W$$

where:
S - represents entropy,
k - the Boltzmann constant,
ln - denotes the natural logarithm.
W - the thermodynamic probability of a given state of the system (*statistical weight of the state*). This is the number of microstates corresponding to a particular macrostate of the system. The greater the number of microstates, the higher the statistical weight, and consequently, the higher the entropy.

Boltzmann's entropy equation applies to thermodynamic systems where it is possible to define a set of microstates for a given macrostate. In such cases, entropy is the natural logarithm of the number of possible microstates, reflecting the relationship between the degree of uncertainty (entropy) and the various possible configurations of the microscopic system. The equation indicates that entropy *S* is proportional to the natural logarithm of the statistical weight *W*. Increasing the number of microstates, or the statistical weight, leads to an increase in entropy. From this perspective, entropy is associated with the number of possible microscopic configurations of the system and the degree of uncertainty about the specific microscopic state in which the system finds itself.

Therefore, according to Boltzmann's entropy equation, an increase in the probability *W* signifies an increase in entropy, or an increase in the dispersion of particles. Conversely, there is an inverse relationship: a decrease in the probability *W* corresponds to a decrease in entropy. Consequently, the most probable state of thermal processes occurring in an isolated system is a state of particle dispersion, or in other words, a state of thermal equilibrium (temperature equalization). This implies that the system has reached maximum entropy, achieving maximum particle dispersion and resulting in maximum disorder (chaos). The quantity known as the *state function S* is characterized by the fact that its value depends solely on the system's state, regardless of the path by which that state was achieved. According to the second law of thermodynamics, in irreversible processes occurring in isolated systems, entropy always increases.

The application of this principle in cosmology, concerning the Universe as a whole, dictates the direction of all physical processes. Specifically, in all observable regions of the Universe, irreversible processes unfold in one and the same 'positive' direction of time flow. This is synonymous with the fact that in these regions, entropy is increasing.

Information entropy. In turn, C.E. Shannon (1916-2001), laying the foundations for information theory, considered entropy as a measure of uncertainty about the actual structure of any system. The measure of uncertainty about which message will be emitted by a source of information is a quantity called information entropy H, equal to the average amount of information per message (Shannon's formula):

$$H(X) = -\sum_{i=1}^{n} P(x_i)\log_b P(x_i)$$

where:

$H(X)$ - the information entropy for the information source X,
n - the number of possible values of the random variable,
$P(x_i)$ - the probability of the occurrence of event x_i,
log_b - the logarithm with base b. Often, the natural logarithm (*ln*) is used, which results in information units called bits (bit - the amount of information needed to unambiguously identify an event in two equivalent and independent events).

Information entropy measures the average amount of information needed to describe events in a given source of information. The higher the information entropy, the greater the uncertainty associated with the transmitted information, and lower entropy indicates lower uncertainty.

Probability always falls within the range from *0* to *1*. The logarithm of a number between *0* and *1* is negative. Introducing a minus sign before the sum ensures that information entropy is always non-negative, consistent with the intuition that the more unpredictable a random variable, the greater the entropy.

Information entropy is frequently employed in information theory, coding, and data compression, where there is a connection between information entropy and the efficiency of encoding. Data compression algorithms aim to reduce information entropy by eliminating redundancy, thus shortening the code length needed to convey information.

Quantum entropy. In quantum mechanics, quantum entropy is measured using various metrics, such as von Neumann entropy, Rényi entropy, or relational quantum entropy. These measures reflect certain aspects of uncertainty and lack of information about the quantum system.

Quantum entropy serves as a gauge of the uncertainty or lack of information regarding the quantum state of a system. For a quantum system described by the density matrix ρ, quantum entropy (S) is typically expressed using the von Neumann formula:

$$S = -Tr(\rho \ln \rho)$$

where:
S - quantum entropy,
Tr - the trace, representing the sum of the elements on the main diagonal of the matrix,
ρ - the density matrix describing the quantum state,
ln - the natural logarithm.

It is worth noting that von Neumann quantum entropy is, in a sense, an analogue of informational entropy in the context of classical information theory. It also represents an extension of the concept of statistical entropy within the framework of quantum mechanics. Consequently, it is clear that in an isolated system, the time evolution of quantum entropy is consistent with the second law of thermodynamics, implying that the quantum entropy of a system can either increase or remain constant but cannot decrease.

Indeterminacy and determinacy – axioeventistic approach

Since entropy is generally considered a measure of disorder, the question arises as to whether order can be regarded as entropy with a negative sign. The reasoning leading to this conclusion starts with defining entropy as a measure of chaos (disorganization, disorder).

When asked about negative chaos, the response is that it is the opposite of chaos, meaning order. This might suggest that negative entropy is a measure of non-chaos, or order.

At first glance, the reasoning seems correct, but there is a flaw in it. The source of the error lies in the fact that the numerical characterization of structure is always a positive quantity, and its size can be expressed in units of chaos, i.e., entropy. Entropy is a measure of disorder or unpredictability in a system, which increases with the growing number of possible states the system can assume. These units are always positive because entropy is always positive or zero for an isolated system. In other words, while negative chaos may conceptually represent order, negative entropy is not a valid or meaningful concept in the context of the conventional definition of entropy.

Let's assume we have two rods with lengths of *2* meters and *1* meter, and we measure them using a negative unit, for example, -1 cm. Then, the length of the first rod is: *200 x (-1) = -200 cm*, and the length of the second one is: *100 x (-1) = -100 cm*; since *-200 < -100*, it follows that the first rod (objectively longer: *2* meters) is shorter than the second one (objectively shorter: *1* meter), which is nonsensical.

In physics, entropy is associated with how many possible states a given system can assume, indicating the difficulty of describing its exact state. Thus, when a system is more ordered, there are fewer achievable states, resulting in lower entropy. On the other hand, order is a state in which elements are arranged in an easily controllable manner. Order is nothing but the degree of organization of a given system. In this sense, order and entropy are inversely proportional, but it does not imply that order can be considered as negative entropy.

It follows that measures must be distinct and positive; chaos should be measured in units of entropy, and order - in units of so-called negentropy. Therefore, the following thesis should be accepted:

> **<u>Thesis 4.1.</u> Entropy is a measure of chaos, and negentropy is a measure of order.**

The concept of 'negentropy' was introduced by E. Schrödinger in the work *What Is Life*? (in which he explores the concept of negentropy and its relation to living systems):

> How would we express in terms of the statistical theory the marvellous faculty of a living organism, by which it delays

> the decay into thermodynamical equilibrium (death)? We said before: 'It feeds upon negative entropy', attracting, as it were, a stream of negative entropy upon itself, to compensate the entropy increase it produces by living and thus to maintain itself on a stationary and fairly low entropy level. If D is a measure of disorder, its reciprocal, t/D, can be regarded as a direct measure of order. Since the logarithm of t/D is just minus the logarithm of D, we can write Boltzmann's equation thus:
>
> - (entropy) == k log (t/D).
>
> Hence the awkward expression 'negative entropy' can be replaced by a better one: entropy, taken with the negative sign, is itself a measure of order[92].

Although entropy and negentropy describe opposing processes, they can coexist in a given *Relatively Isolated System*. For instance, a living organism, through its metabolic processes, can maintain its organization and order, representing an example of negentropy. At the same time, however, the same organism releases heat and waste, which is a process that increases entropy.

In an isolated system (in the physics sense) to a high degree (ideally), and in a *Relatively Isolated System* (in the axioeventistic sense) to a moderate degree (realistically), there is a tendency - with changes occurring within the system over a certain period - to decrease the level of organization (tendency towards chaos), signifying an *increase in statistical entropy*. Simultaneously, there is an increase in uncertainty regarding the knowledge of the structure of the given system, signifying an *increase in informational entropy*. As time passes during changes in both an isolated system and a *Relatively Isolated System*, the number of available information for the 'Observer' decreases. Therefore, entropy, broadly understood, serves as a measure of both *chaos* and our *ignorance* (uncertainty, unpredictability) about a given system.

In this situation, the following theses can be formulated:

> **<u>Thesis 4.2.</u> The greater the entropy, the greater the uncertainty (disorder, unpredictability), and thus the probability of the occurrence of a highly organized Relatively Isolated System becomes progressively smaller.**

[92] Erwin Schrödinger (1967), *What is Life*? The Physical Aspect of the Living Cell, Cambridge University Press, p. 73.

For example, in thermodynamics, entropy is associated with the distribution of energy in a system. The second law of thermodynamics states that in an isolated system, entropy always increases or remains constant but never decreases. This means that in natural processes, without additional input of energy, systems tend to move towards higher entropy, which is associated with a greater degree of disorder (chaos).

Similarly, in information theory, entropy serves as a measure of uncertainty or lack of information. The greater the entropy (and thus greater ignorance), the more information is required to unambiguously determine the state of the system. In the case of maximum entropy, information is completely indeterminate, corresponding to the maximum of uncertainty (chaos, lack of knowledge). It is possible, therefore, to formulate the following thesis:

> **Thesis 4.3. The greater the negentropy, the greater the determinacy (order, certainty, or predictability) of the system, and thus the probability of the occurrence of a highly organized *Relatively Isolated System* becomes progressively larger.**

Unlike entropy, which increases in natural processes, negentropy denotes processes leading to a higher degree of order. For example, in information theory and cybernetics, the concept of negentropy is sometimes used to describe a system's ability to maintain or increase its organization over time, such as through information processing.

Currently, we will adopt the concept of entropy (*respectively*: negentropy) for axioeventistic considerations. It should be noted that axioeventism assumes the existence of only *Relative Isolated Systems* (RIS) on any planes of the *Ontic Universe*. In essence, there are no totally closed systems where there is no form of interaction with the environment (material-energetic or informational), except perhaps for the entirety of the Universe (but even this is a highly speculative assumption).

According to the *first assumption of axioeventism*, the *Ontic Universe* is considered on three planes: the structural-static plane (natural, psychic, social reality), the structural-dynamic plane (informational, eventistic, axiocreational, and temporal interactions), and the structural-result plane (information, events, values, and time). All interactions from the structural-dynamic level take place within the so-called *essential triad* specific to each type of interaction within the *Ontic Universe*. From a systemic point of view, the essential triad consists of three elements: the interacting system (active), the interaction process itself, and the system being the object of interaction (passive).

From a *systemic perspective*, the essential triad consists of three elements: the interacting system (active), the interaction process itself, and the system being the object of interaction (passive):

Relatively Isolated System$_x$ (RIS$_x$) – *Interactions - Relatively Isolated System*$_y$ (RIS$_y$)

From a *substantive point of view* in the discussed case, these will be the following essential triads:

Informational triad: informing system – informational interaction – informed system.

Eventistic triad: interacting system – eventistic interaction – influenced system.

Axiocreative triad: valuing system – axiocreative interaction – valued system.

Temporal triad: past system – temporal interaction – future system.

The above interactions constitute a necessary condition for information, events, values, and time (elements of the structural-resultant plane) because without them, these elements would not exist. All interactions fulfil the characteristic of the following thesis:

> **Thesis 4.4. All *interactions* in the Ontic Universe occur in a bipolar manner: towards indeterminacy or determinacy. Indeterminacy is defined by features such as uncertainty, chaos, disintegrative essential proliferation, and the prediction of the future. On the other hand, determinacy is defined by features such as certainty, order, integrative essential proliferation, and the reconstruction of the past.**

The concepts of 'indeterminacy' and 'determinacy' in relation to specific types of ontic interactions have been collectively presented in Table 4.1.

Interactions	**Indeterminacy**	**Determinacy**
Informational	Uncertainty (*infoentropy*)	Certainty (*infonegentropy*)
Eventistic	Chaos (*entropy*)	Order (*negentropy*)

Axiocreative	Disintegrative essential proliferation (*axioentropy*)	Integrative essential proliferation (*axionegentropy*)
Temporal	*Objective time*: reversibility or irreversibility	
	Subjective time:	
	Forecasting the future (*tempoentropy*)	Reconstruction of the past (*temponegentropy*)

Table 4.1. *Indeterminacy a*nd *determinacy* for individuals types of ontic interactions

In the subsequent chapters, individual interactions - informational, eventistic, axiocreative, and temporal - will be discussed in more detail, along with their effects, namely information, events, values, and time.

5. Information and Informational Interactions

The term *'information'* comes from the Latin word 'informatio,' which means representation or image. Some sources trace the origin of the term 'information' to two Latin words: 'informatio' and 'informo.' In ancient and medieval philosophy, this term referred to the result of the cognitive process of conscious entities and simply meant cognitive content. In other words, information is the result of *in-formare*, the formation of cognitive content. To possess information means to have a resource of knowledge about a certain object of cognition. It follows that a necessary condition for the meaningfulness of this term was the existence of a conscious subject in a cognitive relationship to some fragment of reality.

In everyday language, and often in various encyclopaedic approaches, the concept of ‘information’ is still equated with the concept of ‘news’ or ‘messages’; to possess information is equivalent to having a reservoir of knowledge on a specific topic. The term ‘information’ thus functions as a *social category* associated with acquiring, storing, and utilizing cognitive content for purposes pursued by individual humans and social communities.

Only with the development of biological sciences was it observed that animals also possess specific cognitive content and, moreover, are capable of transmitting it to each other. In this way, the term ‘information’ transcended its previous scope of application, becoming a *biological category*. The possession of consciousness by the subject formulating cognitive content ceased to be the same sine qua non condition for information. The next step was to treat any material system, regardless of its nature[93], as a system in which information - alongside mass and energy - constitutes its necessary, inalienable property. The field of application of the term ‘information’ thus extended beyond the realm of living nature, and the term itself became a *physical category*.

At the beginning of the 20th century, due to the inventions of Bell, Morse, and Edison, physicists focused on the physical phenomena associated with transmitting information over distances using

[93] In particular, a system that exemplifies this concept is a *cybernetic system*. Hence, some researchers are inclined to acknowledge that with the advent of cybernetics, information has acquired the status of a *cybernetic category*. The concept of information is fundamental in cybernetics as a science that deals with the control of systems, specifically in terms of their ability to receive information, store it, and process it appropriately.

electrical impulses. The concept of a *signal*, a specific physical process (e.g., the movement of an electric current wave along a transmission line), was distinguished from the concept of *information*, the content of the signal. In the 1920s-1940s, scientists concentrated their research on the bandwidth capacity of communication channels and optimal methods of encoding and transmitting messages. It turned out that the signal transmitted over a telegraph line would 'smear' during transmission, forcing the sender to transmit signals very slowly. Additionally, additional currents in each conductor interfered with the signal, making precise reception impossible.

Thus, the early development of the scientific theory of information was closely linked to the challenges faced by telecommunications. The emerging fields of *cybernetics* (control theory) and *general systems theory* also had a significant impact on the development of information theory.

The theory of information as a separate scientific discipline was initiated after World War II through the work of telecommunications engineer and mathematician Claude E. Shannon (1916-2001) and cybernetics pioneer Norbert Wiener (1894-1948). Drawing on probability theory and thermodynamics, they sought to refine methods of coding that would optimally transmit information and establish measures of information quantity for sets with an infinite number of elements. They also attached particular importance to the precise analysis of characteristics such as information transmission speed, the probability of error in signal reception, and the level of losses during signal transmission.

Types of Information Theory

There are two fundamental types of information theory, encompassing different variations, among which only selected ones will be presented: *quantitative* (classical C. Shannon, quantum, and pragmatic) and *qualitativ*e (semantic and essential).

Quantitative Information Theories

Classical Information Theory by C. Shannon. The theory of information and coding by Shannon was presented in his 1948 article titled *A Mathematical Theory of Communication*, published in the Bell System Technical Journal. In this article, Shannon developed a mathematical model of communication that became the foundation of information theory. In his work, Shannon addressed the following question: how to transmit signals carrying information as faithfully as possible through a communication channel without reducing speed. In the mentioned article, Shannon developed a *mathematical model of communication* that became the basis of information theory:

> The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have meaning; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one selected from a set of possible messages. The system must be designed to operate for each possible selection, not just the one which will actually be chosen since this is unknown at the time of design.
>
> If the number of messages in the set is finite then this number or any monotonic function of this number can be regarded as a measure of the information produced when one message is chosen from the set, all choices being equally likely. As was pointed out by Hartley the most natural choice is the logarithmic function. Although this definition must be generalized considerably when we consider the influence of the statistics of the message and when we have a continuous range of messages, we will in all cases use an essentially logarithmic measure[94].

According to Claude Shannon, the communication scheme can be described using several key elements that constitute the mathematical model of communication:

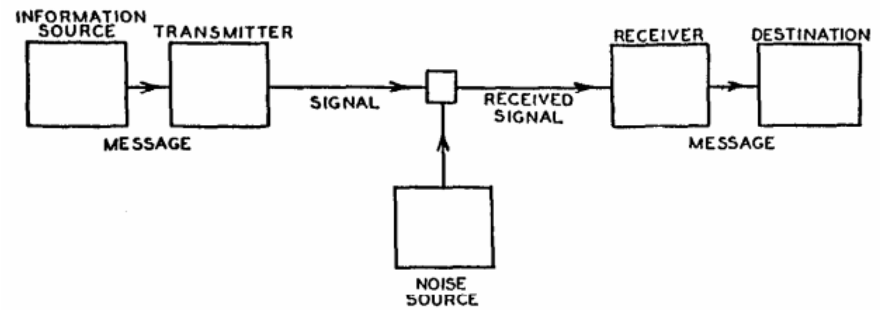

Figure 5.1. Schematic diagram of a general communication system[95]

[94] Claude. Shannon (1948), A *Mathematical Theory of Communication* [in:] The Belle System Technical Journal, Vol. XXXII, No. 3, p. 379.
[95] Ibidem, p. 381.

The Figure 5.1. illustrates the general structure of the communication system, which comprises the following components

Information Source. This is the starting point of the communication process. The source generates information that needs to be conveyed. It could be numerical data, text, images, sounds, or other forms of information.

Transmitter (Encoder). Encodes information into a form that can be transmitted through the communication channel. In other words, it is responsible for transforming information from the source into a format that can be efficiently transmitted through the communication channel. Encoding involves representing information in a way that can be sent and adequately interpreted by the receiver. In the case of *telephony*, this operation simply involves converting sound intensity into proportional electrical current. In *telecommunications*, these operations are usually more complex than in simple examples like telephony or telegraphy. For instance, in Pulse Code Modulation (PCM), a multi-channel modulation system, speech signals must undergo sampling (collecting samples at specific time intervals), compression (data reduction), quantization (assigning quantitative values to samples), encoding (conversion into digital format), and then interleaving (mixing with other signals) before transmission.

Channel. This is the medium through which encoded data is transmitted from the transmitter to the receiver. It can be, for example, a pair of wires, coaxial cable, radio frequency spectrum, a beam of light, etc. The channel is subject to certain disturbances or noise.

Receiver (Decoder). The receiver receives the encoded data from the channel and transforms it back into a form understandable to the recipient. It is responsible for decoding the transmitted information.

Destination (Recipient): The person (or entity) for whom the information is intended. This is the endpoint of the communication process.

Shannon's information theory is closely tied to the above communication system framework. A key element involves considering informational entropy, which is a measure of uncertainty, at each stage of this process. As information moves through different stages, entropy can change. For example, the *transmitter* may introduce certain coding forms that reduce entropy, while the *transmission channel* may add noise, increasing entropy.

Shannon's information theory provides a mathematical tool to describe and quantitatively measure information. It allows the analysis of communication processes in terms of the efficiency of information transmission, considering disruptions and uncertainties.

It should be emphasized that changes in entropy directly impact the amount of information transmitted, generally speaking, from sender to receiver through a specific channel. To realize this, it is sufficient to look at *Shannon's formula defining the quantity of information:*

$$I(x) = - \log_2(P)x))$$

where:
$I(x)$ - the amount of information (in bits) for the event x,
$P(x)$ - the probability of the occurrence of event x,
log2 - the logarithm with base 2.

The above formula is associated with the probability of a given event occurring. It defines the quantity of information as the negative logarithm of the probability of the event. This means that the lower the probability of the event ($P(x)$), the greater the amount of information it provides ($I(x)$).

More precisely, the quantity of information is inversely proportional to the logarithm of the probability of the event. In other words, the higher the probability $P(x)$, the lower the amount of information $I(x)$, and *vice versa*. If $P(x)$ is close to *1* (the event is very probable), then $-\log2(P(x))$ will be close to *0*, indicating that the amount of information is small. On the other hand, when $P(x)$ is close to *0* (the event is unlikely), $-\log2(P(x))$ increases, signifying that the amount of information increases simultaneously.

This formula reflects how highly improbable (surprising) events convey a lot of information, while more predictable events convey relatively little information. In other words, the greater the indeterminacy (uncertainty), or entropy, the greater the amount of information. Changes in entropy significantly impact the amount of information.

The formula for information entropy $H(X)$ in Shannon's theory is defined as the sum of the quantity of information for all possible events weighted by their probabilities. To calculate entropy, we sum the quantity of information for each possible event $(P(xi))$ multiplied by the logarithm to the base *2*. Each individual quantity of information is weighted (i.e., assigned a certain value depending on its probability) by the probability of the occurrence of that event. Shannon's formula for *information entropy* takes the following form:

$$H(X) = -\sum_{i=1}^{n} P(x_i)\log_2 P(x_i)$$

where:
$H(X)$ – informational entropy for information source X,
n – number of possible values x_i of the random variable,
$\log_2 P(x_i)$ - represents the amount of information for each event,
$P(x_i)$ – assignment of weights to each amount of information associated with a given event based on its probability.

Both of Shannon's formulas are based on the concept of probability. The *formula for information* measures the amount of information conveyed by a single event (symbol), while the *formula for entropy* measures the average amount of information in the entire information source, taking into account the probability of each event (symbol). The quantity of information is measured in bits. A *bit* (binary digit) is the fundamental unit of information in this theory. In the context of information theory, one bit represents the amount of information needed to express a choice between two equally likely events. The lower the probability of a particular event, the more bits are required to convey information about its occurrence. In this way, information entropy, which measures the uncertainty or degree of unpredictability of information, is also expressed in bits in the context of Shannon's information theory.

The higher the entropy, the more undefined and diverse the information coming from the source. Entropy can be thought of as the average number of bits needed to encode one symbol from the information source. It's worth noting that entropy reaches its maximum value when all source symbols are equally likely (*maximum uncertainty*), and its minimum value when one event is certain (*no uncertainty).* Entropy is associated with the concepts of unpredictability and the degree of diversity in the information source.

Changes in the entropy of any system signify changes in the uncertainty of that system. When entropy increases, the system becomes more uncertain, meaning that the information is less predictable, and the amount of information for individual events increases. Conversely, when entropy decreases, the system becomes more ordered, resulting in less information for individual events.

In the communication process, reducing entropy can signify more focused and predictable transmitted information. On the other hand, increasing entropy may indicate greater diversity of information and a larger amount of information being conveyed. In other words, higher entropy is associated with a greater amount of information because it signifies greater uncertainty in the system, translating to a larger amount of information needed to describe a particular state of the system.

In the communication process, a greater amount of information can, to some extent, minimize or counteract disruptions. This is especially relevant to the concept of *informational redundancy*; introducing redundant elements can help detect and correct errors in the presence of disturbances, which is particularly important in communication systems susceptible to noise. It also applies to *adaptive communication strategies*, such as increasing the amount of information to adapt to changing environmental conditions.

Quantum Information Theory[96]. One of the key figures in the development of quantum information theory is David Deutsch, a British theoretical physicist. In 1985, he published a paper titled '*Quantum Theory, the Church-Turing Principle and the Universal Quantum Computer'*, where he introduced the concept of a universal quantum computer, making a significant contribution to the field's advancement. His work has influenced the development of quantum algorithms and quantum applications in the field of computer science. Other important researchers associated with quantum information theory include Peter Shor and Lov Grover.

Quantum Information Theory is a field that explores the application of principles from quantum physics in the processing and transmission of information. Quantum information is represented by quantum states of qubits, taking into account both their superposition and entanglement, which opens up new possibilities for storing, processing, and transmitting information in ways impossible in classical information theory. Quantum information concerns the amount of information contained in the quantum state of a given system. In the context of qubits, quantum information refers to the amount of information that can be obtained from measurements performed on a given qubit. Given that qubits can exist in superposition states, one qubit can carry more information than a classical bit in a given quantum state. Superposition of states is, one could say, a crucial aspect of quantum information.

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[96] Let's note that *quantum information theory* is a more theoretical branch of quantum physics that investigates the properties and applications of information in the context of quantum mechanics. It focuses on developing mathematical formalism and understanding fundamental concepts related to quantum information. On the other hand, *quantum computing* is a field of computer science that explores the application of principles from quantum physics to information processing. It emphasizes practical aspects such as quantum algorithms, quantum computations, quantum error correction codes, and so on.

Among the fundamental concepts associated with quantum information theory, the following are noteworthy: quantum bits (qubits), quantum entropy and entanglement, quantum algorithms and quantum logic gates, as well as quantum teleportation and quantum computers.

The concept of qubits: Similar to classical bits, a quantum bit (qubit) is a unit of information, but unlike a bit, a qubit can exist in multiple states simultaneously due to the phenomenon of quantum superposition:

> In information theory, the term 'bit' refers to two related but distinct things. We first encountered it as the unit of information, associated with using logarithms in base 2. The term is also used to describe a physical system with two distinct physical states. These two are connected, of course, by the fact that the physical bit can hold a maximum of one bit of information. A qubit is a quantum system having two distinct, that is, orthogonal, states. We label these states with a zero and a one, $|0\rangle$ and $|1\rangle$. Clearly a qubit can hold one bit of information by virtue of it being possible to prepare it in either of these states. Where a qubit differs from its classical counterpart, however, is that the superposition principle tells us that the qubit can be prepared in any superposition of the states $|0\rangle$ and $|1\rangle$, that is, $a_0|0\rangle + a_1|1\rangle$, where a_0 and a_1 are complex numbers.[97]

Furthermore, unlike classical bits, it is impossible to precisely copy any unknown quantum state. This phenomenon is known as the *No-Cloning Principle*. In other words, it means that there is no universal quantum cloner capable of copying any quantum state into another identical state. This principle is derived from Heisenberg's uncertainty principle. If it were possible to make identical copies of quantum states, it would be possible to simultaneously measure two independent physical quantities (e.g., position and momentum), which is prohibited by the uncertainty principle.

The No-Cloning Principle is particularly relevant in the context of quantum cryptography because it ensures that an identical copy of any unknown quantum state (information) cannot be created without disturbing its state. If it were possible to clone arbitrary quantum states, an unauthorized person could copy a quantum cryptographic key, posing a threat to the security of the cryptographic protocol.

Quantum Entropy and Quantum Entanglement.

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[97] Stephen M. Barnett (2009), *Quantum Information*, Oxford University Press, p. 45.

Quantum entropy, also known as von Neumann entropy, is a measure of uncertainty or the spread of the quantum state of a given system. This concept is analogous to classical informational entropy in classical information theory, but it has specific features arising from the principles of quantum mechanics. Von Neumann entropy is defined based on the density operator (Hermitian matrix) and the mathematical trace (a mathematical operation assigning a real number to a finite square matrix):

> The entropy or information derived from a given probability distribution is, as we have seen, a convenient measure of the uncertainty associated with the distribution. If many of the probabilities are large, so that many of the possible events are comparably likely, then the entropy will be large. If one probability is close to unity, however, then the entropy will be small. It is convenient to introduce entropy in quantum mechanics as a measure of the uncertainty, or lack of knowledge, of the form of the state vector. If we know that our system is in a particular pure state then the associated uncertainty or entropy should be zero. For mixed states, however, it will take a non-zero value. The most natural way to define this entropy is to adopt von Neumann's form,
>
> $$S(\hat{\rho}) = -Tr(\hat{\rho}\log\hat{\rho})$$

where:
S – von Neumann entropy,
$\hat{\rho}$ - the density operator for the system,
Tr – mathematical trace,
log – natural logarithm[98].

Von Neumann entropy for a system in a pure state (i.e., possessing well-defined observable values) is equal to zero, indicating a lack of uncertainty. For a system in a mixed state (a 'blurred,' undefined state with various quantum states), the entropy is greater than zero, signifying the presence of a certain degree of uncertainty or lack of information about the system's state. In general, it can be said that the more concentrated the probabilities are in one quantum state, the lower the entropy, corresponding to less uncertainty.

Quantum Entanglement. Quantum entanglement, in the context of quantum information theory, is a phenomenon where the states of two or more quantum objects are closely correlated, even if they are significantly separated. The change in the state of one quantum

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[98] Ibidem, p. 197.

object immediately influences the state of the other. Quantum entanglement enables the transfer of quantum information between quantum objects in a way that has no equivalent in classical information theory:

> Entanglement is a property of correlations between two or more quantum systems. These correlations defy classical description and are associated with intrinsically quantum phenomena. For this reason, entanglement has played an important role in the development and testing of quantum theory. It is also a central element in quantum information. It is not easy, however, to give a precise definition of entanglement other than that it is a property of entangled states. The problem is then shifted to defining the entangled states. It is simpler, however, to define states that are not entangled[99].

It is challenging to precisely define the phenomenon of quantum entanglement. Nevertheless, certain characteristics are associated with it. These include the following:

Inability to describe independent states. If two objects are entangled, it is impossible to precisely describe their states as combinations of independent states of each. In other words, an entangled state cannot be decomposed into separate states of individual quantum objects.

Mutual correlation of quantum states. Changing the state of one object immediately influences the state of the other, even if they are distant from each other. This non-local dependence of states is characteristic of quantum entanglement.

Inability for local separation of information. Entanglement prevents the local separation of information about one object from information about the other. The information is "entangled," and changes in one object immediately affect the other, regardless of the distance between them.

Impact of measurement on entangled particles. Measuring one of the objects in a certain state immediately determines the state of the other, regardless of the distance between them.

Quantum entanglement plays a crucial role in quantum information theory, especially in the realm of quantum information processing and quantum communication. Furthermore, the existence of quantum entanglement enables quantum teleportation.

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[99] Ibidem, p. 49.

Quantum Algorithms and Quantum Logic Gates. Quantum computers leverage the principles of quantum superposition and quantum entanglement to process information in a manner that is incomparably faster than traditional computers. They utilize quantum algorithms and quantum logic gates.

Quantum algorithms are general computational strategies based on the principles of quantum information theory. They encompass a complete set of instructions and operations that allow for information processing utilizing quantum principles, including quantum superposition, entanglement, and quantum interference (the strengthening or weakening of quantum probabilities due to the overlapping of quantum waves). Examples of quantum algorithms include Shor's algorithm for factoring numbers, Grover's algorithm for searching unsorted databases, and many others (such as Deutsch-Jozsa, Simon's, or Bernstein-Vazirani).

On the other hand, *quantum gates* are specific components that perform quantum operations on qubits:

> The processor acts on the qubits following an instruction set encoded in the arrangement of its quantum gates. Finally, the information is extracted at the end of the process by measuring the state of each qubit in a suitable basis, usually the computational basis of $|0\rangle$ and $|1\rangle$. The processor can induce any desired unitary transformation on the qubit string. Our quantum computer differs from a Turing machine in two important ways. First, the input qubits can be prepared not only in the computational basis, but also in any superposition state. Secondly, a Turing machine proceeds by a deterministic sequence of classical operations; this means that we could, at any stage, stop its operation, examine it, and then make it continue its task. For a quantum information processor, of course, any such intervention would modify the state of our qubits and it would then not be possible to resume the processing operation[100].

Quantum gates are the quantum counterparts of classical logic gates, but they operate on quantum principles. Quantum gates are used to manipulate quantum states, enabling the execution of quantum operations such as superposition, entanglement, and quantum teleportation. They are fundamental tools for constructing quantum circuits that implement specific quantum algorithms.

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[100] Ibidem, p. 169.

Classical logic gates are basic components of electronic digital circuits. They are physical or virtual elements that perform logical operations on binary signals (*0* and *1*). Key classical logic gates include '*and*', '*or*', '*not*' and '*xor*'. Classical logic gates are nothing more than computational equivalents of traditional logical connectives. For example, the *'and' gate* constitutes a physical implementation of the logical conjunction operator in mathematical logic.

Among the more well-known *quantum gates* are the Hadamard gate (H) and the Controlled-Not gate (CNOT). The Hadamard gate (H) operates on a single qubit, transforming it from the standard basis (|0⟩, |1⟩) to the Hadamard basis (|+⟩, |−⟩). It is particularly useful in Grover's algorithm for searching unsorted databases and determining the initial state. On the other hand, the Controlled-Not quantum gate (CNOT), also known as the CX gate, is one of the fundamental two-qubit gates. It is used to perform logical operations on two qubits, where the state of one qubit controls the operation on the other. The first qubit is called the control qubit, and the second is the target qubit.

Quantum teleportation and quantum computers. In the context of quantum physics, the term 'teleportation' refers to the process of quantum teleportation, which allows for the transfer of quantum information between two points in quantum space without the physical movement of the object (qubit). This process is based on the phenomenon of quantum entanglement and does not enable the transfer of matter in a way that would be inconsistent with classical intuition. Quantum teleportation is possible thanks to the phenomenon of quantum entanglement. Entanglement allows for the correlation of two qubits in such a way that changes made to one qubit immediately affect the other, even if they are distant from each other. By utilizing entanglement, quantum information can be transmitted between two remote points without the physical movement of qubits. It may even create the impression that the information has reached its destination before being sent:

> In quantum dense coding, we use two qubits to send two bits of classical information, but one of these qubits has been sent to Bob before Alice has selected the values of the two bits for transmission. It is almost as if one of the bits has been sent ‘backwards in time’ from Alice to Bob via the source of the entangled qubits. Is it also possible to use this strange method of communication as a quantum channel to send quantum information from Alice to Bob? Remarkably,

> the answer is yes; Alice can send a qubit to Bob using just one ebit and two bits of classical information. The method, discovered by Bennett, Brassard, Crepeau, Jozsa, Peres, and Wootters, is quantum teleportation[101].

In the context of quantum teleportation, Alice wants to transmit a qubit to her partner, Bob. However, before making a measurement on her qubit and choosing the state she wants to transmit, she and Bob jointly prepare a pair of entangled qubits (*ebits*). An *ebit* (entangled bit) is a unit of measurement for quantum entanglement, a specific type of quantum correlation between two qubits. If two qubits are in an entangled state, one *ebit* corresponds to a unit amount of this correlation. The term 'entangled qubit' is sometimes introduced to refer to one of the two qubits in an entangled pair. The process of preparing entangled qubit pairs is one-time, and after this initialization, one of these pairs is sent to Alice, while the other remains with Bob.

The procedure of quantum teleportation proceeds as follows:

Initialization of entangled qubits (ebits). Alice and Bob jointly prepare a pair of entangled qubits, one for Alice and one for Bob. The state of these qubits is determined before any measurement takes place.

Transmission of one qubit to Alice. One qubit from the entangled pair is sent to Alice, and the other remains with Bob.

Measurement and transmission of classical bits. Alice performs a measurement on her qubit (the qubit she wants to teleport), leading to one of two possible values. She communicates the result of this measurement to Bob using classical bits.

Restoration of the state in Bob's qubit. Based on the received information, Bob performs operations on his entangled qubit (which remained with him), restoring the state of the original qubit transmitted by Alice.

It is worth noting that the transmission of classical information (measurement results) between Alice and Bob occurs at a speed not exceeding the speed of light, following the principles of the theory of relativity. In this sense, no information is transmitted '*backward in time*', but thanks to the phenomenon of entanglement, it is possible to transfer quantum information between two points in quantum space.

In the realm of classical information theory and physics, there is a principle known as the *causality principle*, which posits that no information can move faster than light. This means that information

[101] Ibidem, p. 129.

cannot reach a certain place before it is sent. In the context of quantum information theory, quantum teleportation may sometimes give the impression that information has reached its destination 'sooner' than would be expected from classical intuition. However, in reality, quantum teleportation does not enable the surpassing of the speed of light or the transmission of information in a manner that would violate the causality principle.

In quantum teleportation, although quantum information is 'transferred' between two distant qubits, the actual transmission of information in this process depends on sending classical informational bits through a classical channel. The classical information sent by the sender to the receiver must travel at a speed not exceeding the speed of light, following the constraints of the theory of relativity. Thus, in quantum theory, although certain aspects of quantum processes may seem paradoxical from the perspective of classical intuition, these principles do not violate the fundamental constraints associated with the causality principle.

It should be emphasized that one of the more promising applications of quantum information theory is the development of quantum computers. They utilize the principles of 'superposition' and 'quantum entanglement' to simultaneously process many possible solutions, enabling the resolution of specific computational problems incomparably faster than in classical computers. Quantum algorithms, such as Shor's algorithm for factorizing numbers or Grover's algorithm for searching unsorted databases, demonstrate potential advantages over classical algorithms.

Pragmatic Information Theory, developed in part by *Philip Dawid* and *Robert G. Valenta*, differs from classical information theory in its approach to the definition of information. In Pragmatic Information Theory, information is associated with utility and its impact on decisions, rather than solely with the quantity of data or the degree of uncertainty. Philip Dawid, a British statistician, was a key contributor to this theory, especially in the context of Bayesian statistics. Robert G. Valenta also played a role in the development of Pragmatic Information Theory, particularly in the context of decision theory.

Certainly, let's talk a bit about the version developed by the Polish philosopher and logician *Klemens Szaniawski* (1925-1990). In general, Szaniawski defined information as the resolution of a question about a set of possible states of affairs, with the purpose of using the obtained answers (thus, information) to make optimal decisions regarding a particular course of action. Szaniawski considered one of the meanings of the term 'information,' where it has a direct connection to decision-making. In this sense, he speaks of so-called pragmatic information, emphasizing that it is meant to serve a purpose. This type of information is consistently linked to the decision-making problem, aiming to answer questions about how to evaluate information in terms of its utility in decision-making.

As a result, it leads to the formulation of the following definition:

> The pragmatic information of a set *X o S* with respect to decision problem *U* will be understood as the (average) improvement in decision-making in *U* due to *X*. This definition imposes itself. If the decision-maker does not know which *x* in *X* is true, they simply maximize u averaged using *p(s)*. If, on the other hand, they know the true *x*, they maximize u with respect to the conditional measure *p(s/x);* what they obtain in this way must be averaged over all x in X[102].

The measure of the quantity of information within both the quantitative and qualitative theories, according to Szaniawski, is comparable; the difference lies only in the type of relationship. In the first case, an increase in information signifies a decrease (reduction) in uncertainty, while in the second case, it denotes an increase in usefulness. In this context, every piece of information with a non-zero value is considered useful either positively (*increase*) or negatively (*decrease*).

Szaniawski's primary focus in the context of information theory was the issue of the usefulness of information for solving decision-making problems. Specifically, the reduction of uncertainty associated with states of affairs over which the decision-maker has no control but which influence the consequences of actions taken. According to him, reducing this uncertainty would contribute to making better choices in actions.

[102] Przez pragmatyczną informację zbioru *X o S* względem problemu decyzji *U* będziemy rozumieli (średnie) ulepszenie decyzji w *U* ze względu na *X*. Ta definicja narzuca się sama . Jeśli podejmujący decyzję nie wie, które *x* w *X* jest prawdziwe, to po prostu maksymalizuje u uśrednione za pomocą *p(s).* Jeśli natomiast zna prawdziwe *x,* to maksymalizuje u względem miary warunkowej *p(s/x);* to, co w ten sposób otrzyma, musi być uśrednione po wszystkich *x* w *X* [in:] Klemens Szaniawski (1994), *O nauce, rozumowaniu i wartościach. Pisma wybrane* (On Learning, Reasoning and Values: Selected Writings), Wyd. Naukowe PWN, Warszawa, p. 413.

Qualitative theories of information

Semantic theory of information. It is an interdisciplinary field that encompasses aspects of philosophy, mathematics, computer science, communication theory, and other disciplines. It is worth noting that the semantic theory of information develops in various fields, such as philosophy, mathematics, computer science, making it difficult to attribute it to a single creator. It is rather the result of collaboration among many researchers with different specializations.

The semantic concept of information has been developed by various researchers in different fields, and it is not possible to unequivocally point to a single creator of this concept. However, several key scientists and thinkers can be identified who have played a significant role in the development of the semantic theory of information and related concepts.

Among many, the following names should be mentioned: Philosopher *Hilary Putnam*, who, in his works related to the philosophy of language and mind, analyzed the meaning and semantics of terms. Mathematician *David Hilbert* influenced the development of semantics in mathematics. His work on formalizing the language of mathematics and the logical analysis of term meanings played a role in shaping the semantic concept of information. Philosopher *Donald Davidson* was interested in the relationships between language and the world and issues related to interpretation. His work influenced the development of semantics and the semantic theory of information. Anthropologist *Gregory Bateson* introduced the concept of 'information' in the context of communication between organisms and the environment. His work in cybernetics influenced the development of the semantic theory of information.

Semantic Information Theory is a branch of information theory that focuses on the meaning of information for the recipient, including how specific information contributes to reducing uncertainty in situations requiring particular decisions. This occurs through pattern recognition, context analysis, and data interpretation in a way that is useful for the information recipient. Meaning is often associated with semantic representation, i.e., the way information is encoded in language. In contrast to traditional quantitative information theory, semantic information theory assumes that information itself does not have value; it acquires value only in appropriate contexts understood by the information recipient. Semantic Information Theory is applied in fields such as artificial intelligence, natural language processing, and the relationship between natural and 'artificial' (formal) languages.

Essential Information Theory by M. Mazur. It is essential to distinguish the so-called essential qualitative theory of information from semantic qualitative information theory, created by the Polish cybernetician Marian Mazur (1909-1983). Unlike the previously discussed concepts, Mazur's theory aims to explain the essence of information. According to Mazur, Shannon's information theory is a quantitative theory of ‘amount of information’, not ‘information’ itself. He emphasizes that Shannon's theory focuses on the task of ‘reproducing’ a message at a certain location that was transmitted elsewhere, and it does not concern the content of the messages.

The starting point in M. Mazur's essential theory of information is the control process based on the feedback of two systems. The control itself is understood as a sequence of physical states in the control path. In a physical sense, information is any mapping of one physical state to another during the control process. This is equivalent to the following formulation:

> The transformation of one message into another (e.g., from an original to another original or from an image to another image) can be considered as information. In this sense, information is a relationship between two messages, and one can argue that information is contained within these messages (originals, images). Taking this into account, one can introduce a terminological convention: informing is the transformation of information contained in originals into information contained in images[103].

This kind of approach satisfactorily explains, according to the author, the transfer of information through various physical phenomena, the possibility of copying information, modelling information, or modelling phenomena of one kind using phenomena of another kind. Every process that can be deemed ‘informational’ is also ‘energetic’, i.e., associated with the expenditure of a certain amount of energy. The difference boils down to a different point of

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[103] Informacja, jako transformacja jednego komunikatu w drugi (np. oryginału w inny oryginał bądź obrazu w obraz), jest związkiem między dwoma komunikatami i w takim sensie można mówić, że informacja jest zawarta w tych komunikatach (oryginałach, obrazach). Biorąc to pod uwagę można wprowadzić ponadto konwencję terminologiczną: informowanie jest to transformacja informacji zawartej w oryginałach w informację zawartą w obrazach [in:] M. Mazur (1976), *Cybernetyka i charakter* (Cybernetics and Character), PIW, Warszawa, p. 110.

view; if we are interested in the transformation of structure (control), we say that a given process is informational, and when we are concerned with performing work, we refer to the process as energetic.

Axioeventistic Approach to Information

The starting point for the concept of information in axioeventism is the so-called *informational triad*, which includes:

informing system – informational interaction – informed system

Every system, including the informing and informed system, constitutes - according to the third assumption of axioeventism (Chapter 1.3.) - a *Relatively Isolated System*. Therefore, the informational triad can be presented as follows:

Relatively Isolated System$_x$ (RIS$_x$) – *Informational Interactions* - *Relatively Isolated System*$_y$ (RIS$_y$)

Traditionally, *informational interaction* between two systems is understood as the process of exchanging information between these two systems. In the context of this term, the information transmitted between systems can influence the way these systems operate or can be used, for example, in decision-making. Examples of such informational interaction between two systems include data transmission in computer networks, the exchange of genetic information between organisms in molecular biology, or communication between different units in artificial intelligence systems. However, this approach does not bring us any closer to understanding the essence of information (about which no information theory, except M. Mazur's essential one, particularly strives).

However, it is essential to note that in every case of informational interaction, the essence involves a change in the state or other properties of the informed system due to the dynamic action of the informing system. Taking this into account, we introduce the following definition of informational interaction:

> **Def. 5.1. *Informational interaction* is the interaction between any Relatively Isolated Systems (RIS) through a material-energetic or epiphenomenal carrier (i.e., mental, social, intelligible) with the aspect of increasing uncertainty (infoentropy) or reducing uncertainty**

(infonegentropy). In other words, it is the process of shaping the form of RIS_y by RIS_x.

Thus, the informing system interacts informatively with the informed system, introducing specific changes within it. In other words, the informing system transforms the informed system, giving it a certain form, and this, within the framework of axioeventism, constitutes the essence of information.

> **<u>Def. 5.2.</u> *Information* is the form of Relatively Isolated System$_y$ (RIS_y), meaning a set of changes within Relatively Isolated System$_y$ (RIS_y) under the influence of informational interaction from Relatively Isolated System$_x$ (RIS_x)**

Informational interaction and its effect, i.e., information, therefore pertain to all possible events in the Ontic Universe, whether in the structural, dynamic, or resultant planes. Informational interaction, in a sense, constitutes a preliminary condition for all other types of interactions (eventistic, axiocreative or temporal). It should be emphasized that it does not require (it is not a necessary condition) the existence of any conscious subject (e.g., the process of dune formation carries specific information regardless of whether there is a conscious observer of this process or not).

However, in the context of analyzing the informational triad, considering a conscious subject, three properties associated with it are highlighted: certainty (predictability) or uncertainty (unpredictability), and probability. These are undoubtedly significant for a conscious subject in a cognitive, purely epistemological sense.

> In communication theory we consider a message source, such as a writer or a speaker, which may produce on a given occasion any one of many possible messages. The amount of information conveyed by the message increases as the amount of uncertainty as to what message actually will be produced becomes greater. A message which is one out of ten possible messages conveys a smaller amount of information than a message which is one out of a million possible messages. The entropy of communication theory is a measure of this uncertainty and the uncertainty, or entropy, is taken as the measure of the amount of information conveyed by a message from a source. The more we know about what message the source will produce,

the less uncertainty, the less entropy, and the less information[104].

Indeterminacy expresses *infoentropy*, which, in the context of informational interaction, is a measure of uncertainty (unpredictability) about the state in which a given Relatively Isolated System remains while interacting informatively with another.

> **<u>Def. 5.3.</u> *Infoentropy* – the degree of uncertainty (unpredictability) regarding the magnitude of changes in RIS_y under the influence of the interaction of RIS_x.**

Infoentropy measures the degree of uncertainty associated with changes (events) occurring in Relatively Isolated Systems under the influence of informational interaction. The formula for infoentropy is nothing else but, as discussed earlier, the formula for Shannon's information entropy:

$$H(X) = -\sum_{i=1}^{n} P(x_i)\log_2 P(x_i)$$

The higher the entropy, the greater the uncertainty (unpredictability). Generally, when the probability of changes (events) is high, the entropy is low, meaning that these changes (events) provide less information because they are more predictable. On the other hand, when the probability of changes (events) is low, the entropy is high, indicating that these changes (events) provide a lot of information because they are less likely and, therefore, more unexpected.

There is a close relationship between probability and information and infoentropy:

> **<u>Thesis 5.1.</u> The higher the probability of changes in a Relatively Isolated System (occurrence of an event), the lower the information and lower the infoentropy. Conversely, the lower the probability of changes in a Relatively Isolated System (occurrence of an event), the higher the information and higher the infoentropy.**

In the context of informational analysis, it can be stated that the higher the probability of an event, the lower the information, and simultaneously, the higher the entropy. An increase in probability means that the event is more predictable and less surprising, resulting

[104] John R. Pierce (1962), *Symbols, Signals and Noise: The Nature and Process of Communication,* Harper & Brothes, New York, p. 23.

in less information and, at the same time, lower entropy, i.e., lower uncertainty or unpredictability. Information is inversely proportional to probability, and infoentropy (uncertainty) is inversely proportional to probability.

Information is inversely proportional to infoentropy. This means that the greater the information, the greater the infoentropy, or more precisely: the amount of information is inversely proportional to the logarithm of the probability of changes in the system (events):

$$\textit{Information } I = -\log_2 (\textit{Probability})$$

This formula uses a logarithm with a base of *2*, which is a standard practice in information theory, meaning that the unit of information is a *bit*. The smaller the probability, the higher the value of the logarithm, leading to a greater information value (less probable events are more informative). Conversely, the larger the probability, the lower the value of the logarithm, indicating a smaller amount of information (more probable events are less informative).

On the other hand, determinacy is expressed by *infonegentropy*, which, in the context of informational interaction, represents the degree of certainty (predictability) or the reduction of uncertainty about the state in which a given Relatively Isolated System remains while interacting informatively with another. In other words, it is a measure of the extent to which one can predict the magnitude of changes (events) in a Relatively Isolated System that is interacting informatively with another:

> **Def. 5.4.** ***Infonegentropy*** **- the degree of certainty (predictability) regarding the magnitude of changes in the** $\mathbf{RIS_y}$ **under the influence of the interaction with** $\mathbf{RIS_x}$**.**

There is a close relationship between probability and information and infonegentropy as well:

> **Thesis 5.2. The higher the probability of changes in a Relatively Isolated System (occurrence of an event), the lower the information and higher the infonegentropy. Conversely, the lower the probability of changes in a Relatively Isolated System (occurrence of an event), the higher the information but lower the infonegentropy.**

We must take into account that the term 'certainty' in the analyzed context refers to the degree of predictability or expectation of certain changes in a *Relatively Isolated System*. It does not, however, refer to the permanence or stability of the system itself.

Therefore, in this context, if an event (changes in the system) is more probable, it is consequently more predictable, meaning greater certainty (infonegentropy) about its occurrence. On the other hand, if the probability of an event (changes in the system) is small, that event is more unexpected and provides more information, meaning we have less certainty (infonegentropy) about its occurrence.

It should be emphasized that the term *'information'* is more closely related to the concept of *probability*, while the terms '*infoentropy*' and '*infonegentropy*' are associated with the concepts of '*certainty*' (predictability, determinacy) and '*uncertainty*' (unpredictability, indeterminacy), respectively. However, it is important to note that traditional information theories (especially quantitative ones) generally do not use the term '*negentropy*' and therefore, they lack a direct equivalent indicating that an increase in '*negentropy*' increases certainty, thereby reducing uncertainty.

Finally, let's note that the definition of information (Def. 5.2.) allows for two interpretative aspects: structural and interactional.

In the *structural* aspect, information is a certain way of organizing any relatively isolated system that determines its structure and potential interactions with other relatively isolated systems. It may be the case that the system is also the carrier of its information, for example, the micro and macro states of a physical object (the material on which the organization is encoded - internal information) or it may be that the organization of the system is recorded on a medium separate from the system itself - external information (for example, the organization of a literary work recorded on paper or electronically). Of course, the criterion of the internality or externality of information is always relative to some other relatively isolated system; a musical score, for example, can be treated either as internal information by a professional musician or as external information for a music lover unfamiliar with musical notation, who appreciates the musical work not by reading the score but in the concert hall. It follows that the issue of the information carrier is secondary and irrelevant from the perspective of the essence of information.

In the *interactional* aspect, information denotes the effect of interaction between any Relatively Isolated Systems (in the understanding of the informational triad). A particular case of such understood information is that which occurs in a set of such systems, of which at least one is a conscious entity. However, the sender or receiver of informational interaction endowed with consciousness is only a special case, and in no case is it a necessary condition for informational interaction. Although there are positions among theorists according to which information is treated precisely as an attribute of conscious entities, as a process of becoming aware by a conscious entity of the surrounding physical reality, in which other conscious entities are also found. *Axioeventism* does not assume the necessity of the existence of a conscious entity on any plane of the Ontic Universe.

6. EVENTS AND EVENTISTIC INTERACTIONS

In traditional eventism, the term ‘*event*’ is typically considered as a primitive term, and thus, indefinable. This is the approach taken, for example, in the *punctual eventism* concept proposed by the Polish philosopher Zdzisław Augustynek (1925-2001).

> The first thesis of eventism asserts that the only individuals are physical events, and the collection of all events constitutes our universe (universal set), denoted by the letter S. The elements of this set, which are events, are represented by letters x, y, z, etc.; thus, we have x, y, z, ..., ∈ S. The term "event" is not defined here. (…)
> The second thesis of eventism claims that things (bodies) are certain properties of a subset of S. The set of all things is denoted by the letter T, and its elements, which are things, are represented by letters a, b, c, etc. Therefore, we have a, b, c, ..., ∈ T, and according to the assumption, a, b, c, ..., □ S. The term "thing" is also not defined here[105].

The ontology of eventism, formulated in the thesis that only events exist, seems to be contradictory to common sense and, more importantly, impossible to reconcile with physics. This is because it appears to negate the existence of things and the relations between things and events. According to Z. Augustynek, the solution to this problem is simple – one just needs to adopt the assumption that things are certain sets of events, and these sets do not have to be definable. Similarly, one can assume that the relations between events are subsets of the appropriate power set of the Cartesian set of events. These simple assumptions serve as the starting point for a coherent theory of eventism in Augustynek's version – punctual eventism, which, in his opinion, constitutes an adequate ontology for relativistic physics.

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[105] ‘Pierwszą tezą ewentyzmu jest twierdzenie, że indywiduami (jedynymi) są zdarzenia fizyczne; zbiór wszystkich zdarzeń stanowi nasze uniwersum (zbiór uniwersalny). Zbiór ten oznaczamy literą S, zaś jego elementy, tj. zdarzenia, literami x, y, z, itd.; mamy więc x, y, z, …, ∈ S. Terminu „zdarzenie” nie definiuje się tutaj. (…) Drugą tezą ewentyzmu jest twierdzenie, że rzeczy (ciała) są pewnymi właściwościami podzbioru S. Zbiór wszystkich rzeczy oznaczamy literą T, zaś jego elementy, tj. rzeczy literami a, b, c, itd. Mamy zatem a, b, c, …, ∈ T oraz, zgodnie z założeniem – a, b, c, …, □ S. Terminu „rzecz” także się tutaj nie definiuje’. Zdzisław Augustynek (1979), *Przeszłość, teraźniejszość, przyszłość. Studium filozoficzne* (Past, Present, Future: A Philosophical Study), PWN, Warszawa, s. 14.

In the context of axioeventism, the starting point is the *eventistic triad*:

interacting system – eventistic interaction – influenced system.

Eeventistic interaction is defined as follows:

> **<u>Def. 6.1.</u> *Eeventistic interaction* is the interaction between any Relatively Isolated Systems (RIS) through a material-energetic or epiphenomenal (i.e., mental or social) medium towards the generation of chaos (entropy) or towards the generation of order (negentropy) in the Ontic Universe (OU). In other words, it is the process of decay (chaos) or aggregation (order) of any RIS at any levels of the OU.**

On the other hand, an *event* is defined as follows:

> **<u>Def. 6.2.</u> *An event* is any Relatively Isolated System RIS_y that is the result of eventistic interaction by the Relatively Isolated System RIS_x. If the RIS lies on the entropy increase or negentropy decrease axis, it is called a *regressive event,* and if it lies on the entropy decrease or negentropy increase axis, it is called a *progressive event.***

Eventistic interactions, and consequently - events, i.e., any sets of Relatively Isolated Systems (an event is the entire eventistic triad and its individual elements), fill the entire spectrum of the Ontic Universe, namely, all its planes (structural-static, structural-dynamic, and structural-result). They constitute one of the modes, a way of manifesting ontic interactions (alongside informational, axiocreational, and temporal). Indeterminacy is expressed by entropy – a measure of chaos, and determinacy – negentropy, a measure of order [see: Thesis 4.1. and Thesis 4.4.]. In the OU, processes of entropy and negentropy change occur simultaneously with varying intensity, depending on the nature of the OU plane and in relation to its specific fragment.

> **<u>Thesis 6.1.</u> The greater the *entropy*, the greater the chaos in the set of any Relatively Isolated Systems (RIS), and the smaller the entropy, the smaller the chaos in the set of any Relatively Isolated Systems (RIS).**

The above thesis has a general application, but it is particularly grounded in thermodynamics. Entropy increases towards more chaotic systems. When the entropy of a given system increases, it signifies that energy becomes more dispersed, and the system becomes more disordered. This is related to the second law of thermodynamics, which states that the entropy of a closed system never decreases and typically increases in natural processes.

> **<u>Thesis 6.2.</u> The greater the *negentropy*, the greater the order in the set of any Relatively Isolated Systems (RIS), and the smaller the negentropy, the smaller the order in the set of any Relatively Isolated Systems (RIS).**

The above thesis, like Thesis 6.1., has a general application. Negentropy is a concept associated with the opposite direction of entropy. It represents the degree of order, organization, or structure in a system. In physics, especially in the context of thermodynamics, negentropy is sometimes used to describe the degree of organization in a system. A system with higher negentropy may be more organized and characterized by a more distinct structure. This is particularly evident in the context of living organisms, which serve as examples of systems with high negentropy. Generally speaking, the higher the negentropy, the more order or structuring can be ascribed to a given system.

A special case of eventistic interactions is *factual interaction*, which is one captured by a hypothetical observer within a certain defined, relatively minimal, time interval. The elements of this particular type of eventistic interactions are called *facts*.

> **<u>Def. 6.3.</u> A *fact* is an event captured by the Observer within a certain defined, minimal spacetime interval $<t_1P_1 - t_2P_2>$, where: *t* – time, *P* – space. Formally: $<Z\ (t_1P_1 - t_2P_2)>$. In the case where *P* represents natural reality, and the natural fact constitutes a relatively permanent and static material-energetic object, it is then called a *thing*.**

An example of a natural fact that is a *thing* could be Earth, while an example of a natural fact that is not a thing could be the Solar System or an atmospheric discharge. Examples of *psychological facts* include experiencing pain or contemplating the opera Carmen, and examples of *social facts* include the Battle of Grunwald in 1410 (a historical fact).

7. VALUES AND AXIOCREATIVE INTERACTIONS

7.1. Fundamental axiological positions in the axioeventistic perspective

General concepts express not only the essence of good within individual classes of beings, to which moral qualifications can sensibly be attributed, as Socrates believed, but according to Plato, they express the essence of all possible beings that are or can exist in the universe. Plato expanded Socrates' theory of ethical concepts to encompass the entire reality. General concepts in Plato's philosophy are referred to as 'ideas'. The world of ideas is a realm of abstractions experienced through reason; ideas are unchanging, absolute, and eternal. In this understood world of ideas, they form a coherent and hierarchical system, with the idea of the *goodness* at the forefront alongside the ideas of *truth* and *beauty* (the so-called *Platonic Triad*).

When it comes to the historical overview, it is necessary to indicate the basic concepts of good, truth, and beauty discussed below.

G o o d n e s s

Antiquity has given rise to two types of ethics (ethics being the most important branch of axiology – the theory of values) in which virtue (*aretology*) or happiness (*eudaimonology*) is considered the highest good (*summum bonum*). The Middle Ages (Thomas Aquinas) and the Renaissance (Hugo Grotius) attached particular importance to natural law. The Enlightenment introduced the concept of duty (deontology) and utility (utilitarianism) into ethics. Below, these concepts will be briefly discussed.

Ancient aretology and eudaimonology (Table 7.1.).

Ethical System	**Summum Bonum**	**Essence of Summum Bonum**	**Eudaimon ia Condition**	**Essence of Eudajmonia Condition**
Intelectual Areteism (Ethical Intellectualism)	arete	epistheme	arete	knowledge of what is good and what is bad (arete = epistheme → eudaimonia)

Autarchic Areteism (Cynicism)	arete	autarky	arete	self-sufficiency and indifference (adiaphora) towards everything (arete = autarky → eudaimonia)
Apathetic Areteism (Stoicism)	arete	apatheia	arete	peace of mind achieved through conformity with nature (arete = apatheia → eudaimonia)
Hedonistic Eudaimonism (Cyrenaicism)	eudaimonia	hedone	hedone	pleasure, bolidy, positive, momentary (eudaimonia = hedone)
Ataraxic Eudaimonism (Epicureanism)	eudaimonia	ataraxia	arete	ability to act In accordance with reason leading to ataraxia (eudaimonia = ataraxia ← arete)
Agathic Eudaimonism (Platonism)	eudaimonia	agathon	arete	harmony of the soul bringing man closer to the idea (eudaimonia = agathon ← arete)
Perfectionist Eudaimonism (Aristotelianis m)	eudaimonia	perfektion	arete	approximative ability towards perfection (eudaimonia = perfection ← arete)

Table 7.1. Ancient Ethical Systems

Intellectualism Areteism. (ethical intellectualism, Socratic philosophy). Socrates, the father of European ethics, was a proponent of this view. He strongly opposed the relativism of the sophists, highlighting desirable character traits shared by all people, such as justice, courage, and self-control. He was inclined to designate only these traits as virtues. Socrates'' ethics is founded on three concepts: virtue (*arete*), knowledge (*epistheme*), and happiness (*eudaimonia*), with each of them associated with a particular perspective determining the essence of the concept. Virtue is conceived as the highest good, simultaneously an absolute and unconditional good (*ethical absolutism*). Knowledge conditions virtue and is even synonymous with it. Virtuous living begets happiness; thus, virtue is conducive to happiness (*eudaimonology*: arete = epistheme → eudaimonia).

Autarchic Aretism (Cynicism). The Cynics inherited from Socrates the belief that the most important thing in life is virtue but added their own thesis—everything else is indifferent (*adiaphora*). Knowledge, elevated to a pedestal by Socrates, also falls into the category of indifferent matters. At this point, the paths of the Cynics and Socrates diverged. While virtue constitutes the highest good (*aretism*), there is nothing else worthy of pursuit; thus, knowledge should also be indifferent to the philosopher. A person is a complete moral personality in and of themselves and should strive for absolute self-sufficiency (*autarky*) in every respect, except for virtue. Only then can one achieve a state of happiness (arete = autarky → eudaimonia). The Cynics took Heracles as their model, who engaged in perpetual effort not for personal gain but for the purpose of perfecting his inner self.

Apathetic Aretism (Stoicism). Upholding the Cynics' thesis that virtue is the highest and only good, the Stoics introduced significant complements to it. Primarily, it is crucial to emphasize that they conceived the entire world, both physical and psycho moral, in a materialistic spirit as fundamentally unified substantively and manifesting its actions based on the same principle. The governing principle, called the *law of nature*, which introduces order and harmony into the world, is reason (*logos*). Thus, in the realm of moral phenomena, virtuous life is also determined by reason, which is the embodiment of the laws of nature. Virtuous action is in accordance with the laws of nature, ultimately in harmony with reason. In this respect, to the extent that it is in accordance with reason, it grants freedom from passions and independence from the fate of good or bad (the so-called '*stoic tranquillity of the soul*' - apatheia), which determines the true happiness of a person (arete = apatheia → eudaimonia).

According to Seneca, we call *a person happy for whom disdain for pleasure is a source of pleasure*. Thus, in Stoicism, virtue is defined by the 'reason of nature,' and everything it commands should be realized because it is a necessary condition for a free and happy life. The concept of virtue here has an open and dynamic character. Limiting oneself solely to the realization of virtues and treating the remaining sphere of the world as indifferent things (*adiaphora*), as was the case with the Cynics, would contradict the Stoic conception of the all-encompassing law of nature (logos).

Hedonistic Eudaimonism (Cyrenaicism). Happiness is the highest good and consists of experiencing one's own, bodily, positive, and momentary pleasures. In the version attributed to Antisthenes of Cyrene, this position is called *simple hedonism* (more precisely: simple hedonistic eudaimonism), while so-called c*omplex hedonism* acknowledges, in addition to bodily pleasures, higher-order pleasures—spiritual ones; an example of this is Epicureanism. Both simple and complex hedonism fall under *ethical hedonism* (eudaimonia = hedone), proclaiming the view that people should strive for pleasure as the highest good and recognizing pleasure as the fundamental criterion for the moral evaluation of human behaviour. Meanwhile, *psychological hedonism* belongs to the realm of empirical theories describing human motivation; specifically, it asserts that the sole motive prompting people to activity is the desire for pleasure and the avoidance of pain.

Ataraxic eudaimonism (Epicureanism). The highest good is happiness characterized by experiencing 'the tranquillity of body and soul' (ataraxia), which entails the absence of desire, physical ailments, and mental disturbances. Epicureans also positively define the state of ataraxia as the experience of katasthenic pleasures—spiritual pleasures characterized by a constant level of intensity and temporal extension, meaning they are drawn from the entire time continuum: past, present, and future. They contrast this type of pleasure with kinetic pleasures—bodily and momentary pleasures advocated by the Cyrenaics. The condition for achieving the state of ataraxia is virtuous living (eudaimonia = ataraxia ← arete).

Agathic eudaimonism (Platonism). The highest good is happiness, which consists of the harmony of the soul; a state of complete harmony brings an individual as close as possible in earthly life to the idea of the good (*agathon*). The harmony of the soul is made possible primarily through the practice of cardinal virtues (eudaimonia = agathon ← arete).

Perfectionist eudaimonism (Aristotelianism). The highest good is happiness understood as the perfection of the individual. Aristotle derived this definition from the analysis of human nature as such, recognizing the human's theoretical and practical activity in accordance with reason as definitive. Thus, the realization of the highest potential of a human under the strict guidance of reason must signify a state of self-actualization, which is deemed the most dignified state for a human. Simultaneously, the condition for self-actualization must involve behaviours in accordance with the requirements of the social situation, the demands of coexistence in human groups. Therefore, the dictates of reason recommend avoiding any extremes that could impede the self-realization of other individuals. In other words, the condition for individual perfection and, *eo ipso*, individual happiness is virtuous living, consisting of the continual pursuit of the golden mean between extremes (eudaimonia = perfection ← arete).

Ethics of natural law. During the Middle Ages, Thomas Aquinas made the foundation of all law the eternal law (*lex aeterna*), identical to the divine plan of creation belonging to the nature of God. Therefore, the archetype, source, and ultimate justification of all laws, understood both descriptively as certain regularities and normatively as duties for various actions in nature or human conduct, is the very essence of God, not some specific aspect of His existence, such as the divine will.

Natural law (*ius naturalis*) participates in the eternal law in three ways. Inanimate entities follow natural regularities, non-rational living beings behave in accordance with their instincts, and rational beings participate in the eternal law by following the light of natural reason. Natural reason reveals the most general, fundamental norms of conduct that bind humans in their conscience.

Hugo Grotius earned the title of the father of modern natural law. *Firstly*, instead of the divine essence, traditionally considered the source of natural law, he reintroduced nature-cosmos as the ultimate reason for order. *Secondl*y, he translated the subject matter of natural law, formulated previously in terms of duties imposed on the legislative authority and citizens, into subjective natural rights expressed in terms of individual entitlements (later known as human rights).

During the Enlightenment, a significant reinterpretation of the concept of natural rights in relation to humans took place, mainly involving the introduction of the concept of the state of nature as a pre-social and pre-political state.

Contemporary natural law ethics, being a detailed application of the concept of natural rights, is often practiced as a theory of authentic human goods reflecting rational human nature. In this sense, it remains closely related to the idea of human rights. However, natural rights are not identical to human rights. This is not about a political-ideological context but rather more fundamental differences. Primarily, *natural rights* inherently possess a universal character, and there are to be no exceptions; in contrast, individual *human rights* may be suspended under certain circumstances (e.g., a criminal being deprived of the right to liberty). Natural rights are also considered immutable (except for the so-called dynamic concepts of natural rights and concepts of natural rights with variable content), unchanged regardless of circumstances, whereas human rights may undergo changes, such as certain rights being excluded from the catalog, and other entitlements, especially in the social sphere, being granted the status of human rights.

Ethics of duty (deontology). Deontology is an ethical framework based on the concept of duty. It is primarily associated with the name of Immanuel Kant, who sought a fundamental principle of morality that could serve as a starting point for determining what is morally right or wrong. He found such a foundation, known as the categorical imperative. Ethics of duty significantly differs from ethical systems that rely on the belief that certain personal qualities determine the morality of human behaviour (*virtue ethics*) or seek immutable traits in human nature determining moral value (*natural law ethics*).

Kant particularly criticized ethical systems that assume a desirable state of affairs, for various reasons, to which individuals should strive to be moral (utilitarianism, eudaimonism, hedonism). According to Kant, the only necessary and sufficient condition for the moral character of any conduct is acting out of duty.

Utility ethics (utilitarianism). Utilitarianism, firstly, bases moral judgments on the value of the consequences of actions; the worth of an act is determined by its outcomes. Secondly, it identifies the highest good with utility, utilitarian value *(summum bonum = bonum utile*). Utilitarianism originated from the ethical traditions of Hume, Holbach, and Helvétius, but it was systematized by Jeremy Bentham and further developed by John Stuart Mill, Herbert Spencer, and Henry Sidgwick (known as classical utilitarianism).

The starting point in constructing utilitarian ethics for *Jeremy Bentham* (1748-1832) is *psychological hedonism*[106] – the view that the desire for pleasure and the avoidance of pain are the only motives determining human activity. Bentham based his ethical theory on such a motivational concept. He considers pleasure as the criterion for moral evaluation, and happiness as the goal of individual life. While each person is primarily interested in their own happiness, the

[106] The following versions of psychological hedonism are distinguished: 1. future hedonism - the motive for action is the anticipated (future) pleasure, intended to serve as gratification for specific behaviours; 2. present hedonism - the motive for action is the pleasure currently experienced in connection with the performance of certain actions; 3. past hedonism - pleasant or unpleasant experiences associated with a particular object or state of affairs in the past determine current behaviours related to the same or similar object or state of affairs.

happiness of others significantly influences our own, so individuals, in their well-understood personal interest, should care about the happiness of others. Bentham's ethics, therefore, recommends conduct that aims to increase happiness among people. The fundamental directive in this ethics, known as the *principle of utilit*y, makes perfect sense:

> The principle of utility is the foundation of the present work, so I should start by giving an explicit and determinate account of what it is. By 'the principle of utility' is meant the principle that approves or disapproves of every action according to the tendency it appears to have to increase or lessen - i.e. to promote or oppose - the happiness of the person or group whose interest is in question. I say 'of every action', not only of private individuals but also of governments[107].

Bentham's utilitarianism is commonly referred to as *hedonistic utilitarianism*[108]. It can be characterized by three conditions: 1. dependence of moral assessment on the value of the consequences resulting from the actions taken; 2. acceptance of the thesis that pleasure (happiness) is the highest good (ethical or *axiological hedonism*); 3. adoption of the rule mandating the maximization of pleasure (happiness) for the greatest number of people (the principle of utility).

Two particular issues regarding hedonistic utilitarianism pose interpretational challenges and require careful consideration. The *first* is the question of the utility calculation, and the *second* is the limitation of utilitarianism solely to the assessment of the consequences of an action, without any attempt to delve into the intentions or motives behind the behaviour. *Utility* (utilitarian value) should be understood as a measure of pleasure (happiness) that allows for comparing the magnitudes of pleasant or unpleasant experiences among different individuals and in different circumstances according to established criteria, or in other words, a

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[107] Jeremy Bentham, *An Itroduction to the Principles of Morals and Legislation*, Copyright @ Jonathan Benett (2017), pp. 6-7.

[108] Traditionally, the term used is hedonistic utilitarianism, and it is indeed appropriate when pleasure is considered the highest good. However, in situations where happiness is accepted as the ultimate good, the term 'eudaimonistic utilitarianism' would be more fitting. Nevertheless, in Bentham's conception, happiness is essentially synonymous with experiencing pleasure, so the terms 'pleasure' and 'happiness' can be treated as synonymous. On the other hand, in Mill's conception, the concept of happiness is emphasized more, and thus his theory will be referred to as eudaimonistic utilitarianism.

certain amount of pleasure (happiness) obtained as a result of a person's specific behaviour.

Bentham adopts the following criteria for pleasant (or unpleasant) experiences: intensity, duration, certainty or uncertainty, nearness or farness, fecundity, purity, and extent. However, these criteria cannot be ordered on a scale of corresponding strength (from Stevens' scale[109]) in a way that would allow for precise utility calculation, such as performing addition and subtraction operations. On the other hand, the issue of the consequences of an action, in addition to the validity of separating the moral value of consequences from the actions determining them, boils down to the ambiguity of the word 'consequence.' This term appears in utilitarianism with a dual meaning, once as a result already achieved (existing consequence) and another time as an intended result (anticipated consequence). This ambiguity of the word 'consequence' negatively affects the precision of the utility calculation, as it allows for arbitrariness in the comparative assessment of the consequences of different behaviours.

Jeremy Bentham's views were further developed by *John Stuart Mill* (1806-1873). He retained the conception of ethics in line with hedonistic utilitarianism:

> The creed which accepts as the foundation of morals, Utility, or the Greatest Happiness Principle, holds that actions are right in proportion as they tend to promote happiness, wrong as they tend to produce the reverse of happiness. By happiness is intended pleasure, and the absence of pain; by unhappiness, pain, and the privation of pleasure[110].

However, in the determination of utility, Mill places greater emphasis on the concept of happiness. Therefore, it is justified to refer to this version as *eudaimonistic utilitarianism*. In contrast to Bentham, who was inclined to treat the principle of utility primarily in quantitative terms, allowing for the interchangeability of various types of pleasures (in his words: '*abstracting from other*

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[109] *Nominal scale* - encompasses units that can only be labelled, but their magnitudes cannot be compared (e.g., gender, colour). *Ordinal scale* - allows for ordering of measurement units, but it does not allow for determining differences between them (e.g., various rankings). *Interval scale* - includes units between which equality and differences can be determined, but there is no reference to an absolute or zero point; therefore, it is not possible to precisely determine how many times one value is greater than another (e.g., IQ scale). *Ratio scale* - encompasses units between which equality, differences, and ratios can be determined (e.g., height in centimetres or time in seconds).

[110] John Stuart Mill, *Utilitarianism*, The Floating Press (2009), p. 14.

considerations, a game of push-pin is as good as the arts'), Mill introduced a distinction between higher - intellectual and lower - sensual pleasures (his famous saying goes: '*It is better to be a dissatisfied Socrates than a satisfied pig*'). He also rejected Bentham's utilitarian calculus, legitimizing the principle of utility in a different way—specifically, by the capacity of an individual to experience satisfaction in the face of the happiness of others. This capacity is not a constitutive element of human nature but requires careful nurturing and development in the educational process. Moreover, it has an ambivalent character, as it is oriented towards others on the one hand, and on the other hand, it ultimately considers one's own egoistic good, which is greater the more good it brings to others.

Hedonistic and eudaimonistic utilitarianism have been sharply criticized by the precursor of the British analytical school, *G.E. Moore* (1873-1958), who accuses these positions, among other things, of unwarranted identification of the quality denoted by the word 'good' with the quality denoted by the words 'pleasant' or 'happy,' ambiguity in understanding the term 'desirable,' which can mean both 'desirable' and 'worthy of desire,' as well as inconsistencies in the concept of happiness. Moore is the creator of the so-called *ideal utilitarianism*, in which the classical principle of utility, i.e., maximizing pleasure-happiness for the greatest number of people, is modified and signifies *the sum of good in genera*l. An action is then right when it contributes to increasing the sum of good in the world, and vice versa — an unjust action is one that somehow worsens the existing world.

In contemporary times, utilitarian ethics has acquired a new dimension, often merging it with decision theory or preference theory, and leveraging the conceptual framework developed in economics and political science. In summary, it would be beneficial to present the major variations of utilitarianism.

Based on the criterion of *formulating the principle of utility*, the following types can be distinguished:

Hedonistic Utilitarianism - an action is right[111] if it maximizes pleasures for the greatest number of people.

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[111] In traditional ethics, the terms 'good' and 'right' were often used interchangeably. In contemporary ethics, there is a tendency to distinguish them more precisely. The term '*good*' is associated with the *theory of ethical values* (the theory of moral good), which aims to determine what moral goodness is and what properties are necessary for the results of actions to be considered good and, therefore, promoted. On the other hand, the term '*right*' is linked to the *theory of rightness*, which mainly deals with how individual subjects or institutional entities should respond to what is morally good.

Eudaimonistic Utilitarianism - an action is right if it maximizes happiness for the greatest number of people.

Ideal (Pluralistic) Utilitarianism - an action is right if it realizes no less good than any other possible action in a given situation.

Preference Utilitarianism - an action is right if it serves to satisfy individual preferences, as long as they do not conflict with the preferences of others.

Welfare Utilitarianism - an action is right if it serves to satisfy the interests of an individual, but those that an ideally informed person with established preferences and a strong will would choose, thus representing a situation of perfect choice.

Due to the criterion of *the level of application of the principle of utility*, there is a distinction between act utilitarianism and rule utilitarianism:

Act Utilitarianism (Direct, Simple) - in a situation where a choice must be made between actions, one should anticipate, based on the principle of utility, the value of their consequences and choose the action that produces more good than any other.

Rule Utilitarianism (Indirect) - an attempt to combine the principle of utility with the categorical imperative; in a situation where a choice must be made between actions, one should act in accordance with what the appropriate rule prescribes, regardless of the presumed consequences of the chosen action. On the level of individual moral choices, it is therefore necessary to act in accordance with moral norms, while these norms historically take shape based on the principle of utility, as only those rules of conduct that positively pass the utility test acquire the status of moral norms.

According to *the criterion of the reference system for the principle of utility*, utilitarianism takes the form of either universalistic or particularistic utilitarianism:

Universalistic Utilitarianism - the reference system encompasses all of humanity, and thus, the criterion for evaluating is the well-being of all humanity.

Particularistic Utilitarianism - the reference system is narrowed down to a specific category such as race, nation, state, social class, etc.

Axioeventistic Approach

Goodness (ethical value) - signifies a Relatively Isolated System that constitutes the *optimum of integrative proliferation.* Good lies beyond the scope of the conscious subject (axioontological objectivism) and can be realized in an approximate sense in any fragment of the ontological plane (structural-static, structural-dynamic, or structural-result). Good can be apprehended through intellectual experience (axioepistemological rationalism), taking into account both subjective and objective conditions (the essence of good in a particular fragment of the ontological plane). In its second sense, good is nothing other than *Teleological Abstract* (Table 7.9.) – the supreme element of the Platonic Triad.

> **Def. 7.1.** ***Goodness*: 1. *A Relatively Isolated System* achieving the optimum of integrative proliferation in any fragment of the Ontic Universe. 2. *Teleological Abstract* – the goal of perfect harmony in the Reality of Abstract-Essential Structures - a fundamental element of the Platonic Triad.**

Truth

According to the definition of the Egyptian-Jewish philosopher Isaac ben Solomon Israeli (832-932): '*Veritas est adequatio rei et intellectus*' the correspondence theory of truth, in the classical sense, states that a statement is true only when it speaks about things as they are.

The *classical correspondence theory of truth* has faced several criticisms. Firstly, critics questioned the unclear status of the term 'correspondence' (representation, identity, determination, fulfilment). Another objection was the alleged unjustified structuralization of reality. Critics argued that the world itself is continuous, and its fragmentation occurs through language. Yet another criticism concerns its alleged inoperability—the inability to objectively assess the adequacy of the relationship between 'thought' and the 'thing' to which it refers.

The criticism of the classical correspondence theory of truth throughout history has led to the development of so-called non-classical theories of truth. Examples include the evidentialist, consensus, pragmatic, and deflationary theories.

Evidentialist conception (of obviousness). Advocates of this conception consider the ultimate criterion for accepting a proposition as true to be its obviousness. This tendency to grasp the essence of truth fully emerged for the first time in the philosophy of Descartes; according to him, what is true is what I clearly and distinctly perceive (*verum est quod clare ac distincte percipio*). In the neokantian version of H. Rickert (1863-1936), a sentence is true if it conforms to a certain norm, and we feel that we should accept it because it imposes itself on us with some irresistible necessity. Critics accuse this conception of its focus on subjective feeling, as the sense of obviousness is given exclusively to the person experiencing it. Therefore, an evidentialist-interpreted truth inevitably leads to relativism.

Conception of universal agreement[112]. According to this conception, the truth of a proposition depends on the universal agreement about it. However, the dependence of truth on people's opinions in various matters raises a similar objection to the one in the case of the obviousness conception, namely the lack of reference to objective reality. Moreover, the question arises: what does '*universal agreement'* mean? Some respond that it is the '*statistical majority of the living*', while others argue that it is the '*majority of experts in a given field*'. However, history teaches us that often one expert expresses true judgments, while the majority of them are in error. This was the case with Copernicus' heliocentric theory, which was considered erroneous by the majority of '*experts*' in its time.

Coherent conception. This conception involves considering as true those theories that do not contain contradictory statements within their scope. Each thesis within a given theory should, therefore, be consistent with other theses of that theory recognized as true. However, there is no doubt that coherence is different from truth. Therefore, proponents of the coherence theory of truth add other criteria, such as the criterion of obviousness, *experience*, *simplicity*, or *beauty of the theory*.

This conception defines truth as the coherence of sentences (judgments, propositions) with each other. The decisive criterion for whether a given sentence should be considered true is its consistency with other sentences previously recognized as true. Advocates of this conception (e.g., Poincaré, Ajdukiewicz) are mainly concerned with the logical consistency of sentences with each other, i.e., with non-contradiction and a certain coherence. However, narrowing the conditions of truth only to formal-logical correctness raises serious doubts, especially about the validity of empirical knowledge. After all, one can create correct but inconsistent formal systems that, in terms of reference to empirical reality, will be completely barren.

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[112] As a particular variation of the *conception of universal agreemen*t, we can consider the consensual conception developed within the contemporary German Erlangen School (P. Lorenzen, W. Kamlah, O. Schwimmer). The representatives of this school examine truth from the perspective of a dialogical situation, based on the belief in the special power of the Socratic dialogue.

Some proponents of the coherence theory of truth try to overcome this by linking sentences belonging to a non-contradictory system with empirical experience. But in this situation, a new difficulty immediately arises. It is known that based on the same empirical data, many correct formal systems can be built. So, which system should be considered true, and according to what criterion should the choice be made? Therefore, in addition to the coherence criterion, some additional criteria (e.g., *simplicity*, *harmony*, *elegance*) would have to be adopted.

Pragmatic conception. This conception is advocated by the philosophical direction developed in the American context, known as pragmatism. According to this conception, truth is a judgment whose realization brings tangible benefit, utility; the truth of a statement (judgment, proposition) is thus identified with its usefulness.

Pragmatism unequivocally subordinates truth to utility, thereby degrading the value of truth. This revaluation seems to have been possible only in the American context. The entire tradition of European philosophical thought sees the relationship between truth and utility in a completely different way – a statement is true regardless of its practical implications; it can, but does not have to, lead to useful actions. Moreover, the utilitarian conception leads, and this is the most serious criticism, to *subjectivism* and *relativism*. On its grounds, everyone can have their own truth, which may be in conflict with the truths of other people.

The measure of the value of knowledge is a kind of utility, and in particular, everything that somehow proves itself in action. On the basis of this conception, there is assumed a certain connection between knowledge (judging the truth) and action. According to the pragmatic conception of truth, if actions based on two different theories concerning the same state of affairs are equally effective, then both theories should be considered true. Truth is thus relativized to the effectiveness in achieving the set goals.

Deflationary conception. Most truth conceptions meet Alfred Tarski's condition of adequacy: a sentence of object language *X* is true if and only if *s*, where *s* is the translation of *X* into the metalanguage and a statement of the theory under consideration. Nonetheless, various truth conceptions differ from each other. Since that is the case, the differences may concern only insignificant details because the essence of truth remains unchanged. The predicate '*true*' can be eliminated; it is redundant and can also be expressed without referring to the metalanguage—quotationally (without quotation marks). Truth is not a real property like gravity, for example. Stripping away (*deflation*) all surplus details reduces truth to its proper dimension. Truth is more of a tool for generalization than an essential feature of statements. Statements can indeed be true without structurally reflecting the structure of the world.

Axioeventistic Approach

Truth (cognitive value): it can be *ontic* – there exists an objective external reality in relation to any knowing subject (Object) or *correspondent* – it is possible to adequately, in reference to strictly defined Ontic Essential Situations (OES), map any objects located in individual fragments of the Ontic Universe (OU). Mapping occurs according to the systemic modelling procedure (Chap. 2.2.): extracting S-Objects in the Ontic Universe according to the *identification principle* (Id_{prcp}) and creating S-Constructs according to the *interpretative principle* (Int_{prcp}). There is also truth understood as *Teleological Abstract* – the goal towards which an infinite sequence of approximate mappings of the Reality of Abstract-Essential Structures (RAES) strives.

> **Def. 7.2. *Truth*: 1. *Ontic* – there exists an objective reality independent of any knowing subject. 2. *Correspondence* – the possibility of mapping within specific Ontic Essential Situations (OES) any fragments of the Ontic Universe (OU). 3. *Asymptotic* – the purpose of an infinite sequence of mappings of the Reality of Abstract-Essential Structures (RAES).**

Situational essentialism (Def. 2.12.) is closely connected to the problem of truth – what constitutes the bearer of truth and whether truth precisely specifies all the properties and relations that make up the global structure (Def. 2.5.), especially its fundamental part known as the essential structure. In the correspondence theory of truth, specification is precisely reduced to mapping, but the very concept poses many difficulties in understanding. It is not clear whether it refers to identity, determination, or fulfilment. It is also uncertain whether the bearers of truth should be sentences, beliefs, thoughts, intuitions, etc.

However, a prerequisite for the meaningfulness of the correspondence theory of truth is the assumption of *realism*[113],

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[113] *Axioeventism* takes events as the basic component of the *Ontic Universe* (Def. 1.1.). Nevertheless, *facts* (Def. 6.3.) and *things* (Def. 10.2.) are also treated as events of a

understood here as a philosophical standpoint acknowledging the existence of a reality independent of the knowing subject (objective), whether it is cognized by any knowing subject or not.

> By scientific realism philosophers typically understand a doctrine which may think of as embodying four central theses:
> (i) "Theoretical terms" in scientific theories (i.e., non-observational terms) should be thought of as putatively referring expressions; scientific theories should be interpreted "realistically".
> (ii) Scientific theories, interpreted realistically, are confirmable and in fact often confirmed as approximately true by ordinary scientific evidence interpreted in accordance with ordinary methodological standards.
> (iii) The historical progress of mature sciences is largely a matter of successively more accurate approximations to the truth about both observable and unobservable phenomena. Later theories typically build upon the (observational and theoretical) knowledge embodied in previous theories.
> (iv) The reality which scientific theories describe is largely independent of our thoughts or theoretical commitments[114].

Adopting a realistic stance is something obvious and not open to discussion, as its negation (*anti-essentialism*) implies that all knowledge concerns nothingness (the non-existence of an external reality in relation to the knowing subject), which is absurd. A good example can be the cosmological concept of the *Big Bang*. The essence of the Big Bang is essentially unknown; it is treated as a singularity where the known laws of physics do not apply, and there is no time and space. This singularity can be considered a thing-in-itself in the Kantian sense. However, its existence cannot be ruled out, as in such a case, the entire subsequent evolution of the universe would lose its meaning, lacking any ontic foundation. Thus, what is inherently unknowable serves as an ontic foundation for what emerged later and is progressively understood.

Only after adopting the assumption of realism does the problem of representing this reality in the knowing subject arise. Another assumption (though lacking the attribute of necessity) is *essentialism* (particularly *situational essentialism*) – a

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particular kind. Taking these remarks into account, it can be said that the concept of realism also applies to axioeventism.

[114] Richard N. Boyd, *On the Current Status of the Issue of Scientific Realism*, p. 45. https://jwood.faculty.unlv.edu/unlv/Articles/Boyd1983CSSR.pdf

philosophical position acknowledging the existence and the possibility of knowing the essence of any objects in the Ontic Universe. Thus, essentialism asserts that each event (object, fact, thing, phenomenon) has its essence that determines what or whom it is; moreover, it recognizes that this essence is knowable. In this context, a secondary and non-influential matter for fundamental epistemological resolutions is the question of the possibility of knowing the accidental structure (in addition to the essential one) of any fragments of the Ontic Universe.

It is impossible to maintain the belief that at every level of the Ontic Universe, the structure of its individual fragments remains constant, unaffected by the *identification principle* (Id_{prcp}) of the system that creates the S-object. This is the essence of this principle—it structures the perceived fragment of reality, but it structures it in a precisely defined way determined by the nature of the reality being cognized, while the conditions on the part of the subject are secondary. Moreover, in the systemic approach adopted by axioeventism, the testificational procedure of S-objects and S-constructs unequivocally narrows down any arbitrariness. This procedure does not exclude the use of various truth criteria offered by various truth concepts. These criteria may include, for example, coherence, utility, effectiveness, or praxis.

False is the thesis of all kinds of *constructivists* proclaiming that the subject freely, arbitrarily creates this structure because it is fully dependent on the current discourse. Unfortunately, in contemporary *philosophical constructivism*, truth as an epistemological value and the rationale for accepting propositions and theories gradually diminishes in philosophical and scientific discussions.

Let's take the following example: Let: OES_1 - *the paradigm of Newtonian mechanics*: 1. There exists absolute space, unrelated to anything external, always remaining the same and stationary. 2. Time is absolute, true, mathematical, self-existing, and naturally flows uniformly, unrelated to anything external. 3. Everything is certain and entirely possible to measure arbitrarily accurately if we have the appropriate equipment. *Boundary Conditions* for OES_1: a set of objects fulfilling OES_1.

Let OES_2 - *the paradigm of Einsteinian mechanics*: 1. Space undergoes distortion under the influence of mass. 2. Time is relative and constitutes an equal element of a larger whole called spacetime. 3. There are limits to measurement accuracy regardless of the perfection of measuring tools. *Boundary Conditions* for OES_2: a set of objects fulfilling OES_2.

It is evident that for both OES_1 and OES_2, *ontic truth* is satisfied, i.e., there objectively exist objects described by both Newtonian and Einsteinian paradigms. Otherwise, the propositions contained in them would pertain to nothingness (in the sense of non-existent objects in reality).

It is also evident that for both OES_1 and OES_2, *correspondence truth* is satisfied, meaning there is an adequate mapping of S-Objects (described by both paradigms) into the form of S-Constructs. Otherwise, one would have to acknowledge that the propositions put forth by these paradigms are devoid of meaning, not referring to anything, merely constituting a more or less sophisticated construct.

In relation to both paradigms, truth (*ontic* and *correspondence*) makes sense only to the extent that the proclaimed hypotheses find experimental confirmation and thereby achieve the status of theories. However, for scientific hypotheses, the term 'probability' should be reserved with appropriate estimation.

Beauty

In antiquity, the core of the concept of beauty was the quantitatively determined so-called *proper proportion*, which could appear in two forms: as *universal proportion* constituting universal beauty (pulchrum, bellum), or as *functional proportion* constituting functional beauty (decorum), as discussed by Socrates. Universal beauty encompasses two categories: *musical harmony* – the arrangement of sounds, audible beauty, and *plastic symmetry* – proportionality, visible beauty. On the other hand, functional beauty is related to the category of eurythmy (appropriateness, suitability, utility), which has an *objective sense* – adapting the object to its purpose or destination, and a *subjective sense* – adapting the object to the human perceptual apparatus, in other words, it is beauty for the eyes or ears. The above distinctions can be illustrated as follows (Table 7.2.).

Proper Proportion	Universal Proportion	Musical Hormony
		Plastic Symmetry
	Funktional Proportion	Objective Hormony
		Subjective Hormony

Table 7.2. Types of Proportions

Among the essentially infinite set of universal proportions between any objects in the universe, a particular fame has been gained by the golden ratio or *divine proportion*, popularized within the Pythagorean circle. Due to its origin in dividing a line segment into two parts: the shorter and the longer, it is also known as the golden division of a segment. When extended to regular polygons, it is generally referred to as the golden section, and the numbers expressing the golden ratio or golden division are called the golden numbers.

In the *golden rati*o, the shorter part of the segment relates to the longer part as the longer part relates to the whole. Thus, if we denote the entire segment as *1*, the longer part as *x*, and the shorter part as *1 - x*, the golden ratio can be expressed as follows: $\frac{1-x}{x} = \frac{x}{1}$. From this proportion, we derive a quadratic equation: $x^2 = 1 - x$, which has two solutions: $x_1 = = \frac{\sqrt{5}+1}{2}$ $1.618 = \tau$ and $x_2 = \frac{\sqrt{5}+1}{2} = 0.618$. The numerical values of these solutions are called the golden numbers; the first one is denoted by the Greek letter τ.

Euclid (circa 306-283 BCE), a disciple of the Platonic Academy, provides in his Elements, Theorem 11, a geometric construction of the golden ratio of a line segment. In the 15th century, the Italian mathematician Luca Pacioli wrote a treatise on proportions in architecture titled *De divina proportione* illustrated with drawings by Leonardo da Vinci. The treatise was practically entirely dedicated to the extraordinary properties of the golden number tau. From ancient times to the present day, the golden ratio has been attributed with exceptional aesthetic qualities; it has even been considered a fundamental rule in the visual arts.

In the 3rd century BC, Plotinus (203-270), active in Alexandria, modified the concept of the *proper proportion*. Plotinus' philosophy posited the existence of hierarchical forms of being: the most perfect absolute and emanations from it, progressively less perfect forms, namely the ideal world, which is intellectually knowable; the psychic (spiritual) world, being a direct emanation of the world of ideas; and emanating from the psychic world, the lowest in the hierarchy, the material world, accessible to sensory perception.

According to Plotinus, proper proportion is not a constitutive feature of beauty, determining its essence, but rather a consecutive feature—something that is a consequence, a final result of beauty, perceived either intellectually in the case of abstract beauty or sensually in the case of beauty in concrete objects. In Plotinus' philosophy, entities hierarchically higher than matter take the place of proper proportion as a constitutive feature. These include the psychic (spiritual) entity, as beauty pertains to the elements of the emotional-volitional aspects of the soul (foreshadowing the Enlightenment concept of the artist's expression), or the ideal entity in the Platonic sense. Plotinus speaks of a radiance (*claritas)* that, '*shining through*' material things, imparts beauty to them.

The characterization of beauty is divided into two constituent elements: a *consecutive feature*, something that is a result of something else, for which proper proportion is recognized and a *constitutive feature* - defining the essence of the spiritual or ideal world. Prior to Plotinus, proper proportion in an object was considered a constitutive feature of beauty, but Plotinus degraded it to the level of a consecutive feature. Beauty itself, in Plotinian thought, constitutes a specific quality arising from the combination of both these features; beauty is essentially the *spiritual radiance* (constitutive feature) in the material world or *ideal radiance* (constitutive feature), alternatively, in the spiritual or material world, '*shining through*' via *proper proportions* (consecutive feature), whether abstract or concrete.

The basic aesthetic solutions of ancient Greece will be presented in Table 7.3.

Criterion	**Essence of Beauty**	**Measure of Beauty**	**Aesthetic Experience**
Pythagoreanism	Proper Proportion	Distance	Catharsis
Sophism	Sensory Perception	Intensity of Perceptron	Illusio
Socratism	Functionality	Adaptation	Mimesis
Platonism	Ideal Proportion	Approximation	Anamnesis
Neoplatonism	'Shinning through' of the Spirits	Intensity of 'Shinning through'	Simulo

Table 7.3. The basic aesthetic solutions of ancient Greece

Pythagoreanism - Beauty lies in the proper proportion determined numerically; in relation to audible beauty known as 'harmony' and in relation to visible beauty – 'symmetry' *Nomos* in music and *canon* in art contained precisely established rules enabling the achievement of proper proportions. The measure of beauty is the deviation of actually realized proportions in a given creation from proper proportions, assessed by experts. Aesthetic experience involves *catharsis* (purification), the quieting or pacifying of human passions, thereby achieving the purification of the soul.

Sophism - beauty is everything that evokes pleasant sensations for the eyes and ears of a person. The measure is the degree of intensity of pleasant sensations. The aesthetic experience is *illusio* the illusion experienced by the recipient under the influence of certain objects, for example, *works of art: acting art deceives the conscious; what actors say is different from what they think.*

Socratism - beauty consists of the functionality of any objects, i.e., their adaptation both to the purpose they are intended to serve and, in the case of works of art, to the audience. The measure is the degree of adaptation to the purpose or the audience. Aesthetic experience is based on *mimesis* (imitation), intellectual decoding of the content contained in works of art, finding similarities between objects depicted in the work and real-world objects.

Platonism - the essence of beauty boils down to Pythagorean proper proportions, placed in the realm of eternal, static ideas, and for this reason, they are simultaneously ’ideal’ proportions. The measure of the realization of beauty is the degree of approximation achieved in the material. Aesthetic experience is based on *anamnesis* (recollection), the viewer recalling the structures of the ideal world, similar to the creative process, observed before birth.

Neoplatonism - beauty is synonymous with spiritual or ideal radiance 'shining through' the material. The measure of beauty is determined by the intensity of this 'shining through.' Aesthetic experience, on the other hand, comes down to *simulo* (making similar), the viewer assimilating themselves to the beauty they are perceiving.

The Christian Middle Ages inherited fundamental aesthetic ideas from ancient philosophy, specifically the Great Aesthetic Theory and Neoplatonic theory. According to Neoplatonism, beauty is *claritas*, a reflection and sign of a higher beauty inherent in the invisible world. Thus, beauty in its ontologically highest dimension is an attribute of the One-God (Pseudo-Dionysius the Areopagite), is the beauty of God - the source of other kinds of beauty (St. Augustine), and is ultimately transcendental, a universal property of being (St. Thomas Aquinas)

Visible, sensory beauty is a sign of divine beauty, and this thesis contributed, in a theoretical sense, to the ultimate triumph of the supporters of the veneration of holy images - *iconophiles* - in the 9th century, both in the Eastern and Western Churches. The Christian symbolism, which resulted from the above thesis and was initiated by Pseudo-Dionysius the Areopagite based on Neoplatonic mysticism, and further developed in the work *Mystagogy* by Maximus the Confessor, had a strong influence on Christian liturgy and art.

Thus, the *number one* was a symbol of perfection. The *number three* was a symbol of the Holy Trinity since the mystery of God himself is revealed in this number. Hence, it appears in sacred architecture, including the three-part division of the façade and side aisles. The temple as a whole also represented a triple symbol; the temple was a symbol of God in the Holy Trinity, hence it had three identical facades, and the 'sole light' entered its choir through three windows. Secondly, it was a symbol of the Church, founded by Christ and '*represented its foundations: the apostles, prophets, and martyrs*'. Thirdly, the temple was a symbol of the cosmos. The *number seven* is also considered sacred; there are seven virtues and seven gifts of the Holy Spirit, which were established after lengthy disputes. The *number eight*, on the other hand, is obtained by adding the perfect number (seven) to one; for example, according to Christ's sermon on the mount, there are eight beatitudes.

Modern Period. Renaissance philosophical-aesthetic thought, similar to medieval philosophy, still revolves around two luminaries of classical antiquity - Plato and Aristotle. Two prominent centers in this field were the Platonic Academy, founded in Florence in 1462, which drew inspiration from Platonism, and the University of Padua, promoting the philosophy of Aristotle. Aristotelian philosophers in Padua were less concerned with the theory of beauty and more with the theory of the arts, primarily poetry. On the other hand, Platonists from the Platonic Academy in Florence devoted considerable attention to the issue of beauty and the theory of visual arts. One of the most famous figures was *Marsilio Ficino* (1433-1499). His distinction between beauty (*pulchritudo*) and beautiful things (*res pulchrae*) is well-known. Beauty is a value in itself, something inherently objective and unchanging, while beautiful things only have the appearance of beauty because they may seem beautiful at one time and not at another; for example, human bodies are 'beautiful things' because they are beautiful today, but tomorrow, with a slight change, they may not be.

A separate place is occupied by *Leon Battista Alberti* (1404-1472). He had no interest in philosophy, describing himself as a theorist of the visual arts. He is the author of three significant works*:* *On Painting* (De Pictura), *On Architecture* (De Re Aedificatoria), and *On Sculpture* (De Statua). Alberti constructed the modern ideal of art following the ancient model, emphasizing the importance of craftsmanship and theoretical knowledge. He particularly stressed the significance of painting, which he regarded as '*the inspiration for all other arts*'. According to Alberti, a painter should possess diverse knowledge: geometric, anatomical, as well as a deep literary and philosophical culture to create perfect works. Theory and creative intent, in Alberti's view, should precede the actual process of creation. It is not surprising that the fundamental artistic category for Alberti became the concept of '*disegno*' (drawing) in a specific sense as a '*design conceived by the mind*' or '*conceptual thought*'. In the 16th century, disegno almost became synonymous with art in general, as drawing became the primary form of clarifying artistic intent for all visual arts.

The Renaissance brought about a significant elevation in the status of the artist as a creator compared to the medieval period. The medieval artist primarily served functional roles: serving God, the ruler, and society. Due to the 'servitude' of artistic work, medieval creators generally remained anonymous, and works were signed solely with workshop marks. In the Renaissance, thanks to new theories of creativity, the artist's work shifted from the realm of craftsmanship to the sphere of intellect. Leonardo da Vinci, in particular, likened artistic creation to divine creative activity. According to him, drawing (*designo*) is '*not only knowledge but a divine attribute deserving proper reverence, as it reproduces all visible things created by the Supreme God*'.

The Enlightenment and Contemporary Period. Enlightenment aesthetics, especially post-Enlightenment, abandons the classically understood concept of beauty. It relinquishes one aesthetic category in favor of many separate, often not only unrelated but distinctly opposed ones. In the 18th century, there was a crisis in the concept of beauty as proper proportion. On one hand, empirical philosophy argued that beauty is significantly dependent on subjective human reactions to specific object properties, and aesthetic experiences are not always unambiguously linked to objects possessing classically understood proportions. On the other hand, representatives of the Romantic movement argued that beauty lies more in fullness, picturesque qualities, and expression than in regularity and proportion. This was a qualitatively different theory of beauty.

At the same time, the traditional concept of accepting the notion of beauty as superior to individual aesthetic categories (e.g., *charm, subtlety)* is challenged. In the 18th century, there was an awareness of the qualitative distinctiveness of known categories, and as a result, they began to be considered autonomous—distinct aesthetic values irreducible in any way to the concept of beauty. *J. Addison's trisection of aesthetic* values into beauty, greatness, and uncommonness (beautiful, great, uncommon) gained a lasting position in Enlightenment aesthetics.

Also well-known was the set proposed by *J.W. Goethe*, which listed the following aesthetic categories: depth, inventiveness, plasticity, sublimity, individuality, spirituality, nobility, sensitivity, taste, accuracy, appropriateness, force of action, elaborateness, gracefulness, fullness, wealth, warmth, charm, beauty, allure, dexterity, lightness, liveliness, delicacy, brilliance, inventiveness, stylishness, rhythm, harmony, purity, correctness, elegance, perfection.

In the 19th century, *F. Th. Vischer* employs a less detailed classification, listing the following aesthetic values: beauty, sublimity, pathos, miraculousness, buffoonery, grotesque, charm, grace, and neatness. A more well-known categorization is presented by the contemporary French aesthetician E. Souriau: beauty, grandeur, grace, sublimity, tragedy, dramatics, wit, comedy, humor, elegy, pathos, fantasy, picturesque, poeticism, grotesqueness, melodramatics, heroism, nobility, lyricism.

One of the particularly interesting contributions to aesthetics comes from a Polish phenomenologist, ontologist, and aesthetician – *Roman Ingarden* (1893-1970).

> Ingarden also undertook general work on the ontological status of the aesthetic object and the nature of aesthetic values, as well as phenomenological work on the experience of works of art of various kinds. On the object side, as we have seen he distinguishes in each case between the mere physical object and the work of art; but he also distinguishes both of these from what he calls the “concretization” (sometimes translated as “concretion”) of the work of art, which he considers to be the true ‘aesthetic object’. The work of art itself, in the case of most forms of art such as literature, painting, or music, is what Ingarden calls a “schematic formation.” That is, it has certain ‘places of

> indeterminacy', many of which are filled in by an individual interpretation or 'reading' of the work[115].

R. Ingarden distinguishes artistic values of a work of art from aesthetic values. According to him, every work of art is not only a specific physical object (e.g., a painting canvas) but also, and actually primarily, a so-called *intentional object*, i.e., a result of the creative acts of the artist placed in a given ontological basis. The work of art (physical object plus the creative invention of the artist) is by its nature indeterminate and thus subject to concretization, i.e., various interpretations and determinations made by the recipient of the work of art. The essentially unlimited concretization of a work of art yields an *aesthetic object*. *Artistic values* (e.g., visual arrangements on a painting canvas) are objectively inherent in the work of art. On the other hand, *aesthetic values* are formed through the recipient's contact with artistic values in the process of aesthetic experience.

One must clearly distinguish the *essential artistic situation* from the *essential aesthetic situation*. The former occurs between the artist and the work through artistic creativity. The latter takes place between the work of art (or the natural environment) and the recipient through aesthetic experience. The relationship of artistic creativity, constituting the essential relationship for the artistic situation, simultaneously belongs to a broader category—creativity in general, which includes scientific, philosophical, technical creativity, etc. Therefore, it must inherently possess the characteristics that determine that a certain type of human activity is classified as creativity.

Not very precisely, but perhaps sufficiently for our considerations, one could say that creativity involves solving some original, atypical problem. For a scientist, such a problem might be the necessity of explaining, within the current knowledge, some natural phenomenon that is not understood. And for a creative technician, it could be the construction of a device that processes energy with given, previously unused parameters.

And what is artistic creativity? In antiquity, two terms were used in this case: at times, understanding artistic creativity as conscious production according to rules, and at other times, as imitation of nature. In contemporary times, the concept of artistic creativity is often treated as derivative of the concept of a work of art. This, in a

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115 Amie Thomasson, *Roman Ingarden* (2020), Stanford Encyclopedia of Philosophy, https://plato.stanford.edu/entries/ingarden/#AestObjeAestValuAestExpe

methodological sense, is considered an 'open' concept and as such not subject to strict definitional procedures. At most, it is possible to provide approximate, partial definitions, reflecting only a certain subset of features relevant to a work of art. In this context, terms such as *syntactic saturation*, *exemplification*, *referentiality*, or *expressiveness* are mentioned, which should be used – depending on the specific genre of art – in the analysis of works of art. Only after their application do we obtain a meaningful definition of a work of art *in concreto*.

While *aesthetic values* (beauty, sublimity, grotesque, charm, etc.) are the organizing factors in the aesthetic situation, *artistic values* serve as such factors for the artistic situation. The most significant are, I believe, values of a *syntactic* nature, building the form of the work of art, while values of a *pragmatic* (e.g., expressive-declarative, psycho-volitional) or *semantic* nature (e.g., ideological) are less significant.

Let's take a *painting* as an example to analyze syntactic values. It is distinguished by three fundamental layers: the *material* (objective) layer, the *compositional* layer, and the *figurative* layer.

Material (objective) layer. It consists of: the material (canvas, wood, plywood, cardboard, glass, as well as: paints, oils, adhesives, etc.) and the texture, shaped by appropriate techniques on the surface of the painting.

Depending on the *type of paints*, there are distinguished: encaustic painting - the use of liquid beeswax; fresco - pigment rubbed in lime water; tempera - diluted pigment mixed with fresh yolk; watercolor - pigment dissolved in gum arabic; oil - pigment mixed with edible oil; acrylic - pigment mixed with synthetic resin - polymer.

Due to the *way texture is shaped*, the following techniques are mentioned: *Divisionism* - applying small strokes of paint next to each other in such a way that a luminous colour is created (a variation is *Pointillism* - applying dots). *Tachism* - spontaneously painting with random splotches and streaks of paint (a technique especially used in Informalism). *Collage* - shaping the surface of the painting by gluing random cutouts of materials such as paper, straw, fabric scraps. Leonardo da Vinci used a technique called *sfumato* - blending, which gave a shadow shaping the form. Surrealists introduced several new techniques, including *frottages* - rubbing the surface of rough objects with chalk on paper; *fumages* - smoking and scorching the paint. Polish artist Tadeusz Kantor (1915-1990) introduced the *embalage* technique, wrapping and packaging; thus, embalage paintings, embalage costumes, embalage letters, etc., were created.

Compositional layer. The analysis of a painting within this layer concerns the shaping of visual elements, visual arrangements, and the organic structure of the work.

Visual elements - these are the basic visual features of any objects placed in a painting: line, shape, light and shadow, color (quality, value - the degree of lightening or darkening, saturation - the degree of intensity).

Visual arrangements - sets of visual elements forming certain wholes that can be distinguished in the painting. Typical visual arrangements in a painting include *flat arrangements*: 1. distinguished by the placement of visual elements - central, rhythmic, symmetrical, with dominance. 2. distinguished by the criterion of movement: static and dynamic. 3. distinguished based on organic compactness: open or closed arrangements. Another type of visual arrangement is *illusory-spatial arrangements* - ways of seeing and presenting space on a plane, i.e., various types of perspective (converging - linear, colour - painterly, strip, coulis, intentional, and diverging).

Organic structure - the homeostasis of a work of art in the broad sense of the word, i.e., the balance of visual elements and visual arrangements, achieved through the appropriate distribution of plastic masses and balancing the direction of their forces. Shaping the organic structure is primarily an intuitive activity, but intellectual reflection and experience also play a significant role.

Figurative layer. It encompasses the representation of any group of objects in specific relationships to each other. The figurative layer may contain a single object, such as the reflection of a model, or multiple objects creating a representational situation, a so-called plot (e.g., depicting the Battle of Grunwald). In works of art containing a figurative (representational) layer, various ways of interpreting the represented objects should be distinguished (realistic, surrealist, naturalistic, essentialist, and expressionist):

Realistic interpretation - presenting objects with an objectifying intention, i.e., based on sensory observation corrected by intellectual analysis. Regarding the issue of proportions in representations, a specific type within this interpretation can be identified, namely, *ideoplastic realism* (especially in relation to children's creativity), which reflects the proportions of the world according to one's own individual hierarchy of importance, regardless of objective proportions.

Surrealist interpretation - realistically representing unreal themes, drawn from extraordinary, mysterious phenomena, dreams, and visions of mad people.

*Naturalistic interpretatio*n - copying the appearances of things; representing them as they are, without specific selection and evaluation. An offshoot of the naturalistic vision of the world is *impressionism*, which emphasizes subjective, individual perception of the world at a specific moment in time, considering the entire palette of colours and shapes resulting from visual illusions. Another variation of naturalism is *verism*, which gives the appearance of complete authenticity to artistic fiction (found particularly in literature and opera).

Essentialist interpretation - reflecting the 'essence' of things, without fundamentally paying attention to their external, 'superficial' appearance. A good example of this type of interpretation is the painting of Paul Cezanne. His intention was precisely to find the essence of things and reflect it in the painting. After many searches, he concluded that the reflection of the essence of things occurs through the synthetic capture of their form, understood as shape. According to him, the infinite variety of shapes that things take in the world can be reduced to basic geometric solids: the sphere, the cylinder, and the cone. The artist's task is to depict in the painting these basic solids in such a way as to simultaneously preserve the full individuality of the reflected thing.

Expressionist interpretation - aims to intensify the expressive power of the depicted object through appropriate deformation techniques. Some of the most well-known techniques include:

1. *Stylization technique* - presenting objects and figures in a decorative manner, following the requirements of a specific style or individually adopted convention. Baroque stylization, for example, as seen in Velazquez's work, is expressed in the almost tangible softness of velvets, silks, and lace. In Flemish painting, still life is painted in a colorful and sumptuous manner; Rubens, in turn, proclaims the sensual joy of life expressed in the lush shapes of his women.

2. *Simplification technique* - portraying essential, according to the artist, features of things or figures in a synthetic form.

3. *Caricature technique* - an extreme form of simplification - exaggerating selected, not necessarily essential features of a character and depicting them at the expense of blurring the others.

Beauty (aesthetic value) - signifies sublime contemplation (ennobling; maximum integration of personality at various levels) by the conscious subject.

> **Def. 7.3.** ***Beauty*: 1. *Sublimative contemplation* of the conscious subject towards any fragment of the Ontic Universe. 2. *Teleological Abstract* - a component of the Platonic Triad.**

Beauty, of course, can be contemplated not only in relation to the world of art but equally in connection with the natural environment of humans. There is no doubt that there are various types of sublime contemplation associated with experiencing not only beauty in the classical sense but also encompassing the sublime, grace, romanticism, aesthetic shock, etc. These are synonymous with historically shaped aesthetic categories. Therefore, depending on the considered aesthetic category, one can speak of strictly *beauty-related contemplation*, *sublime contemplation*, *graceful contemplation*, and so on.

7.2. Ontology of Values

Important issues in axiology (the general theory of values) are related to the ontological status of values. One of them is the question of the mode of existence of values, including whether value is an independent object, a property of some object, or something intentional. Another issue concerns the essence and types of values and their potential hierarchy. In the field of axioeventism, four criteria have been distinguished for considering axioontological issues. They are as follows: the mode of existence of values, the nature of values, the relationship of values to the subject in terms of existence, and the synchronous-diachronic scope of values (Table 7.4.).

Criterion	**Axioontological Positions**
Mode of Existence of Values	Substantialism
	Attributivism
	Relationism

	Eventism	
Nature of Values	Naturalism	
	Antinaturalism	
Relationship of Values to the Subject in Terms of Existence	Subjectivism	
	Objectivism	Evaluativism
		Transcendentalism
		Realism
	Relationalism	
Synchronous-Diachronic Scope	Absolutism (Universalism)	
	Relativism	
	Situationism	

Table 7.4. Axioontological Positions

***Mode of Existence of Values*:**

1. *Axioontological Substantialism* - values exist as substantial entities.
2. *Axioontological Attributivism* - values exist as attributes (properties) of substantial entities.
3. *Axioontological Relationism* - values exist as relations between certain objects.
4. *Axioontological Eventism* - values exist as events; more precisely – relatively isolated systems (RIS).

***Nature of Values*:**

1. *Axioontological Naturalism* - value is a certain natural property analogous to physical, psychological, social, or intelligible properties.
2. *Axioontological Antinaturalism* - value is not any (any whatsoever) natural quality.

***Relationship of Values to the Subject in Terms of Existence*:**

1. *Axioontological Subjectivism* - values are a certain psychic experience (thought - mentalism; emotion - emotivism; will - volitionalism); they lie within the realm of the individual subject.

2. *Axioontological Objectivism* - values lie beyond the realm of the individual subject, but ontologically, they may be dependent on the individual subject:

2.1. *Evaluativism* - values are the result of an evaluative (judgmental) process of any events in the universe, a process involving the individual; they inherently lie beyond the individual subject in any fragment of the universe.

2.2. *Transcendentalism* - values exist in the transcendental sphere (e.g., Platonic ideas); they exist beyond the individual subject.

2.3. *Realism* - values lie in any fragment of the structural-static plane: natural, psychic or social world.

3. *Axioontological Relationalism* - values lie between the subject (especially the individual) and the object. This, of course, applies only to those values that are constituted in the world of conscious subjects.

***Synchronous-Diachronic Scope*:**

1. *Axioontological Absolutism* (Universalism) - values are always and everywhere the same.

2. *Axioontological Relativism* - values depend on the system of reference; in some, they are values, and in others, they are not values.

3. *Axioontological Situationism* - values are the same (universal) in specific axiological situations; they are therefore relativized to axiological situations and thus do not possess absolute value.

> **Thesis 7.1.** ***Axioeventism* adopts the following axioontological solutions: *axioontological eventism* (mode of existence of values); *axioontological naturalism* (nature of values); *axioontological realism* (relationship of values to the subject in terms of existence); and *axioontological situationism* (synchronic-diachronic scope).**

Axioontological Eventism. According to Definition 7.2. values exist as events; more precisely, as *Relatively Isolated Systems*, composed of any events existing in some fragment of any plane of the Ontic Universe. It should be noted continuously that values are all possible Relatively Isolated Systems in the sense of Definitions

2.7. and 2.8., thus subject to essential integrative or disintegrative proliferation, and at a specific point, indifferent values may exist. Events (and thus all ontic interactions) considered *in abstracto* constitute purely formal dimensions of the Ontic Universe, as they cannot exist in isolation as elementary events. The situation is different regarding sets of Relatively Isolated Systems (RIS) – they exist in reality, forming various proliferative (integrative or disintegrative) sequences along the 'objective time' line.

Axioontological Naturalism. Value is, in simple terms, a certain property that is an attribute (belonging to the essence) of Relatively Isolated Systems (forming the Ontic Universe) located on integrative or disintegrative lines of essential proliferation and lacking any transcendent reason for their existence. Moreover, each Relatively Isolated System, composed of any events and existing in any plane of the Ontic Universe - considered along the line of essential proliferation - must always constitute some value (integrative-positive, disintegrative-negative, or indifferent).

Axioontological Realism. Values exist in any fragment of the structural-static plane: the physical, mental or social world, implies that values can have any character – whether material, mental or social. Axioontological realism thus means that all events grouped into Relatively Isolated Systems, regardless of whether they are elements of the physical world (such as material objects) or the mental and social world, are real, i.e., they belong to the Ontic Universe. However, it does not mean that they constitute the category of things (Latin: res – thing), as, according to axioeventism, they are nothing more than events considered in certain minimal time intervals.

Axioontological Situationism. Essentialism is a viewpoint recognizing the existence of a strictly defined set of properties and relations inherent to any objects, phenomena, or processes, which unambiguously determines their essence. *Ontic Essential Situatio*n, according to Definition 2.10. is such a Relatively Isolated System to which Boundary Conditions are imposed, and these conditions decisively determine its belonging to a certain class of Relatively Isolated Systems. Regarding values, Ontic Essential Situation takes the name Axioontological Situationism, signifying only that Boundary Conditions determine values that are the same (universal) in specific axiological situations. Therefore, they undergo *relativisation to axiological situations* and, consequently, do not possess absolute value. Thus, Axioontological Situationism represents the opposite of axiological absolutism (of course, within the scope of the Ontic Universe).

Some of the more well-known opponents of essentialism (anti-essentialism) include the American neopragmatist Hilary Putnam and the deconstructionist Jacques Derrida. They took a stance of hard anti-essentialism, vehemently denying not only the possibility of knowing the essence of something but even the existence of essence itself. On the other hand, a determined opponent of anti-essentialism (and thus an advocate of essentialism) is the American philosopher and adherent of Platonism, Richard Malcolm Weaver (1910-1963). In his work *Ideas Have Consequences*, he traces the beginning of the decline of Western culture to medieval nominalism, exemplified by William of Ockham (1288-1347):

> It was William of Ockham who propounded the fateful doctrine of nominalism, which denies that universals have a real existence. His triumph tended to leave universal terms mere names serving our convenience. The issue ultimately involved is whether there is a source of truth higher than, and independent of, man; and the answer to the question is decisive for one's view of the nature and destiny of humankind. The practical result of nominalist philosophy is to banish the reality which is perceived by the intellect and to posit as reality that which is perceived by the senses. With this change in the affirmation of what is real, the whole orientation of culture takes a turn, and we are on the road to modern empiricism[116].

According to Weaver, it was Ockham who, *firstly,* brought about a shift in philosophy from genetic rationalism to genetic empiricism, and *secondly,* replaced metaphysical inquiries with purely logical analyses. Denying the real existence of universals essentially denies everything that goes beyond experience. Moreover, the denial of universals also implies questioning the existence of objective truth, paving the way for relativism (*man as the measure of all things*) and the idea that all *discourses*, even those radically different, are equally valid descriptions of experienced reality. Consequently, starting from the 17th and 18th centuries, there emerged a new understanding of *rationalism* as the rational interpretation, particularly the construction of causal sequences (physical laws) based on sensory

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[116] Richard M. Weaver (1948), *Ideas Have Consequences* , The University of Chicago Press, Chicago, Illinois, U.S.A., p. 3.

data. Questions about the essence and purpose of the world were considered irrelevant and even meaningless.

Additionally:

> Since liberalism became a kind of official party line, we have been enjoined against saying things about races, religions, or national groups, for, after all, there is no categorical statement without its implication of value, and values begin divisions among men. We must not define, subsume, or judge; we must rather rest on the periphery and display “sensibility toward the cultural expression of all lands and peoples” This is a process of emasculation[117].

Due to the fact that different values are valued in different cultures, which may cause divisions between people, the historical necessity of modern times - believe anti-essentialists - deaxiologization appears within discourses taking place in the field of social reality.

7.3. Epistemology of Values

The age-old philosophical problem concerning the possibility and ways of knowing values is entangled in numerous premises and theoretical assumptions within the epistemology of values, often concealed beneath the surface of considerations. However, there are two issues without which it is impossible to sensibly analyze this problem. They concern, *firstly*, the question of cognitive sources, and *secondly*, the relationship between the knowing subject and its object, which, in this case, is the value itself. The table 7.5. presents key positions addressing these matters:

Criterion	**Axioepistemological Positions**
Cognitive Sources	Empiricism
	Rationalism
	Intuitionism
	Emotionalism
	Revelation (subjective and

[117] Ibidem, p. 53.

	objective)
Relation of Values to the Subject in the Aspect of Knowledge	Subjectivism
	Objectivism
	Relationalism
	Relativism

Table 7.5. Axioepistemological Positions

***Cognitive Sources*.**

1. *Axioepistemological Empiricism* - values are apprehended through sensory experience.
2. *Axioepistemological Rationalism* - values are apprehended through intellectual (reason-based) experience.
3. *Axioepistemological Intuitionism* - values are apprehended through a specific axiological intuition.
4. *Axioepistemological Emotionalism* - values are apprehended through emotions (feelings).
5. *Axioepistemological Revelation* - values are apprehended through supernatural revelation.

***Relation of Values to the Subject in the Aspect of Knowledg*e.**

1. *Axioepistemological Subjectivism* - the apprehension of values depends on subjective conditions.
2. *Axioepistemological Objectivism* - the apprehension of values depends on objective conditions.
3. *Axioepistemological Relationalism* - the apprehension of values depends partly on subjective conditions and partly on conditions inherent to the values.
4. *Axioepistemological Relativism* - the apprehension of values is relative; relativisation occurs concerning the subjects perceiving (person *X* experiences object *O* as a positive value, while person *Y* experiences the same object *O* as a negative value) or concerning the situations in which it functions as a value (object *O* is a value in situation S_1, whereas in situation S_2, it is not a value).

Thesis 7.2. *Axioeventism* adopts the following axioepistemological solutions: *axioepistemological rationalism* (cognitive sources) and *axioepistemological*

***relationalism* (the relationship of values to the subject in the aspect of cognition).**

According to axioeventism, the cognitive process of understanding the world of values in a formal sense is an analogy to modelling *Relatively Isolated Systems* [see: Figure 2.1.]. Recognizing the world of values is, in fact, nothing more than modelling Relatively Isolated Systems (RIS) specifically in the realm of values. This procedure unfolds in three stages: extracting *Valid-Values* (analogon: *S-object*) from Relatively Isolated Systems on various planes, constructing *Considered-values* (analogon: *S-construct*), and testifying within the domain (planes) the considered Relatively Isolated Systems.

***Axioepistemological Rationalism*.**

1. Extracting Valid-Value (analogon *S-object*) in the Ontic Universe by identifying a specific fragment within it according to a designated *identification principle* (Id_{prcp}). Valid-Value can be distinguished at the zero (basic) level or at any higher level relative to zero (see: Def. 7.6.)

2. Creating Considered-Values (analogon: *S-construct*) through the interpretation of validation values according to a specific *interpretative principle* (Int_{prcp}). Considered-Value can be distinguished at the zero (basic) level or at any higher level relative to zero (see: Def. 7.7.).

3. Testification of Considered-Value within the domain of specific *Relatively Isolated Systems* (RIS).

Axioepistemological Relationalism. The understanding of values depends partly on subjective conditions (of the perceiving subject) and partly on conditions inherent to the values themselves. The degree of dependence is determined by the nature of the situationist-structural dimension, i.e., in which part of the broadly understood reality they are located, and the situationist-functional dimension of values, i.e., the functions they fulfil in various segments of the broadly understood reality.

7.4. The Essence of Value

Axiocreative interaction is nothing other than ontic interaction of any kind that generates changes in the Ontic Universe, involving either disintegrative or integrative essential proliferation, resulting in Relatively Isolated Systems (RIS) at various levels, from *zero* to *nth*.

It can take various forms depending on the type of plane in the Ontic Universe. Examples include, in physics, material-energy forces; in biology, the principle of evolution or natural selection; in ethics, the principle of altruism or egoism.

Axiocreative interactions are part of the axiocreative triad:

Valuing system – axiocreative interaction – Valued system

Indeterminacy expresses axioentropy, which is a measure of disintegrative essential proliferation describing the degree of realization of negative (disintegrative) values. On the other hand, *determinacy* expresses axionegentropy, which is a measure of integrative essential proliferation describing the degree of realization of positive (integrative) values.

> **<u>Def. 7.4.</u> *Axiocreative interaction* is an interaction of a material-energetic or epiphenomenal (i.e., psychic, social) nature between any Relatively Isolated Systems concerning each other, either towards increasing disintegrative essential proliferation (*axioentropy*) or towards increasing integrative essential proliferation (*axionegentropy*).**

In other words, it is a process of disintegration of Relatively Isolated Systems (towards negative values) or the process of integration of Relatively Isolated Systems (towards positive values) at various levels of the Ontic Universe:

> **<u>Def. 7.5.</u> *Value* is any Relatively Isolated System situated on the integrative line of essential proliferation (*positive value*) or on the disintegrative line of essential proliferation (*negative value*). The boundary point between integration and disintegration is formed by *indifferent value*s.**

> **<u>Thesis 7.3.</u> The greater the axioentropy, the greater the disintegration of the Relatively Isolated System, and the probability of a highly organized system occurring decreases. Conversely, the greater the axionegentropy, the greater the integration of the Relatively Isolated System, and the probability of a highly organized system occurring increases.**

In every process, as entropy increases, the system tends to disintegrate, becoming more chaotic. Simultaneously, the increase in entropy reduces the likelihood of a highly organized system occurring (*with a prevalence of negative values*). Conversely, an increase in negentropy leads to greater integration and order, thereby increasing the probability of a highly organized system emerging (*with a prevalence of positive values*).

It should be emphasized that in the ontic-epistemic sphere, value can manifest in three aspects (*three modes of value*): formal-ontic, as a predecessor-successor relation, and as a means-end relation (Table 7.6.).

Criterion	**Type**	**Meaning**
Formal-Ontic	Positive (integrative)	Result of integrative proliferation
	Negative (disintegrative)	Result of disintegrative proliferation
Predecessor-Successor	Instrumental	Surfing for something
	Intrinsic (inherent)	Not used for anything
	Equivalent components	
Means-End	Value-as-Means	A means to a goal set by a conscious subject
	Value-as-End	The goal set by a conscious subject

Table 7.6. Aspects of Value

1. Value in a broad sense, from a *formal-ontic* perspective, refers to any Relatively Isolated System that determines positive values (integrative proliferation), negative values (disintegrative proliferation), or indifferent values (boundary point).

2. Value from the perspective of the *axiocreative ontic triad* in terms of predecessor (value-predecessor) and successor (value-successor). Value-Predecessor is interpreted here as instrumental value ('*for*'), and Value-Successor as autotelic value ('*in itself*'). Nevertheless, situations where both members of the Relatively Isolated System are equivalent to each other should not be excluded. In a set of any values, one can always establish an order to distinguish predecessors and relational successors. However, it should always be remembered that in a different configuration of

relatively isolated systems, these positions may change, and a value that was an '*in itself*' value may become a '*for*' value if, in this new configuration, it functions as a predecessor rather than a relational successor to another value.

3. From the perspective of the relation: *means-end*, defined in the set of conscious subjects (rather than within any Axiocreative Situation) - predecessor can be identified with a value-as-means to a goal, and successor - with a value-as-end.

7.5. Cognition of values - axioeventistic approach

The process of understanding the world of values in a formal sense serves as an analogue to modelling Relatively Isolated Systems (Chapter 2.2.). Recognizing the world of values is nothing other than modelling *Relatively Isolated Systems* specifically in the dimension of values. This procedure unfolds in three stages: extracting *Valid-Value* from Relatively Isolated Systems on any given plane (object), constructing *Considered-Value*, and testifying to them in the domain of the considered Relatively Isolated Systems.

A x i o e p i s t e m o l o g i c a l   R a t i o n a l i s m

1. Extraction of *Valid-Value* (analogon: S-object) in the Ontic Universe through the identification of a specific fragment within it according to a defined *identification principle* (Id_{prcp}):

> **Def. 7.6.** ***Valid-Value*** **is a such value, in one of its three meanings (Tab. 7.6.), distinguished by a conscious subject in the Ontic Universe due to the identification principles (**Id_{prcp}**) adopted by that subject.**

Valid-Value can be distinguished at the zero (basic) level or at any higher level relative to the zero. For example, zero-level validation could be the combination of two hydrogen atoms (event Z_1, event Z_2) with oxygen (event Z_3) to form water H_2O or the combination of any spatial graphic elements resulting in a drawing that evokes certain aesthetic emotions. On the other hand, higher-level Valid-Value is illustrated by the following examples: a biological organism forming a complex functional whole in the world of living beings (Valid-Value of life) or a painting that meets artistic-aesthetic criteria (allowing for gradation) according to a specific style (aesthetic Valid-Value).

2. Creation of *Considered-Value* (analogon: S-construct) through the interpretation of value-validation according to a specific *interpretative principle* (Int_{prcp}):

> **<u>Def. 7.7.</u> *Considered-Value* is a such value, in one of its three meanings (Tab. 7.6.), that is a model of Valid-Value constructed by a conscious subject due to the interpretative principles (Int_{prcp}) adopted by that subject.**

As an example, let's consider any tree (object) chosen by a painter as a painted object (Valid-Value) delineated according to *identification principle* (Id_{prcp}). The painter may interpret (*interpretation principle* - Int_{prcp}) the tree (as a painted object) based on various aspects, including technical elements (the use of colour and light-shadow), the adopted style of painting (e.g., realism, expressionism, or abstraction), or symbolism (the tree as a symbol of life, nature, relative permanence).

3. Testifying to the value-valence in the domain of specific Relatively Isolated Systems

A x i o e p i s t e m o l o g i c a l   R e l a t i o n a l i s m

Cognition of values depends partly on subjective conditions and partly on conditions related to the nature of values. The degree of dependence is determined by the character of the *situational-structural* and *situational-functional* dimensions of values, which are discussed below.

7.6. Dimensions of values

In Table 7.7. and Table 7.8. the dimension of situation-contact-structural and situation-functional values is presented.

First order values	2nd order Values	Nth order values
Natural	Cosmic	Ecological - Vital …
	Anthropocentric	Intelligence …
Psychic	Emotional	Volitional - Religious …
	Psycho-cognitive	Exploration …

Social	Economic and Political	Utilitarian …
	Cultural	Aesthetic …
	Ethical	Responsibility …
	Legal	Property …
	Socio-cognitive	Technique - Science …

Table 7.7. The Situationist-Structuralist Dimension of Values

Some values in the *Situationist-Structuralis*t dimension belong to the *Ontic Universe* segment, which in its essential layer is not a part of the axiocreational triad interacting with humans (e.g., cosmic values). A significant portion of values belongs to the axiocreational triad, in which one of the elements (valuing system or valued entity) can be a human. Hence, there arises a fairly widespread *axiological illusion of an anthropocentric nature*, according to which the world of values is identified with the human world. In accordance with this illusion, humans (more broadly, conscious subjects) are considered creators of values.

First order values	**2nd order values**	**Nth order values**
Natural	Existential	Vital ...
	Evolutionary	Eco-Systemic …
Psychic	Emotional-Cognitive	Personality ...
	Contemplative	Art - Religion ...
Social	Mediation and Protection	Ethics - Law ...
	Consumption	Utility - Goods …

Table 7.8. Situationist-Functional Dimension of Values

Values in the situation-functional dimension have been distinguished according to a substantive criterion – the function they fulfil within the axiocreational triads (including sustaining or developing Relatively Isolated Systems or achieving consensus among conscious entities).

1. *Existential values* – related to the existence and survival of systems; they pertain to the foundations that give meaning to the life of individuals and society. They include goals that shape how an individual or society understands its existence.

2. *Evolutionary values* – connected to progress (integration) or regression (disintegration) in various fragments of structural dimensions. A good example of such values is those associated with biology. Organisms that have effectively survived and transmitted their genes to offspring have a greater chance of evolutionary success. For this reason, biological mechanisms related to survival and reproduction are considered evolutionary values.

3. *Emotional-cognitive values* – linked, among other things, to personal development, expanding skills and gaining new experiences, empathizing with emotions, or building satisfying relationships with other people.

4. C*ontemplative values* – contemplation by individual X of certain specific objects from any structural dimensions. They are associated with experiencing beauty, inner peace, reflection on existence, as well as developing sensitivity to spiritual or aesthetic aspects of reality.

5. *Mediation and protective values* – related to conflict situations in society. Ethical values serve as mediating values, as their purpose is to resolve, or at least alleviate, conflicts that arise in social life. Legal values provide regulatory frameworks aimed at protecting individuals and social cohesion in situations of conflicting interests.

6. *Consumer values* – especially related to beliefs, attitudes, and priorities that shape consumers' decisions regarding the purchase and consumption of goods and services.

In Table 7.9. the division of *Teleological Abstracts* is presented.

Teleological Abstracts	Positive	Platonic Trinity	Goodness – Truth - Beauty
		Individual	Life – Reasonableness - Dignity of the Person - Self-realization (perfection, happiness, pleasure)
		Collectivity	Justice – Freedom - Security

	Negative	Platonic Trinity	Evil – Falsehood - Ugliness
		Individual	Death – Unreasonableness - Denial of the Dignity of the Person - Self-realization (imperfection, unhappiness, sorrow)
		Collectivity	Injustice – Enslavement - Threats

Table 7.9. Teleological Abstracts

The significance in the above classifications lies, firstly, in their concretization of the ontic dimension of the *structural-static plane* (natural, psychic, and social), and secondly, *Teleological Abstracts* (as a kind of universals) remain unchanged regardless of the dimension of values under consideration. *Teleological Abstracts* are nothing more than abstractions that integrate attributes of any conscious subject to the highest, final degree, from which lower-order values derive in specific ontic planes of structure. For example, a specific individual, based on their personality (or their action or motive), may be good to some extent, thus participating in the Good as understood by Teleological Abstracts. The ontic status of *Teleological Abstracts* is specific; they are exclusively linked to a conscious subject (particularly, a human) and not to any Relatively Isolated System within the Ontic Universe.

As a result of the above findings, we will formulate two theses:

Thesis 7.4. In a *formal sense*, with respect to the entire Ontic Universe, the principle of proliferation signifies the integration or disintegration of Relatively Isolated Systems in a given Essential Ontic Situation on any plane of the Ontic Universe (structural-static, structural-dynamic, and structural-result)

Thesis 7.5. In a s*ubstantive sense*, concerning conscious subjects, the principle of proliferation signifies the directed striving of conscious subjects in the aspect of Teleological Abstracts—both positive and negative.

The Platonic Trinity (*Goodness – Truth – Beauty*) are values that hold the status of *Teleological Abstracts*. This means that these values, like any other teleological values, can only be approached asymptotically by conscious subjects. *Positive values* serve as determinants of the maximum integrative proliferation of essentiality, while *negative values* represent the maximum disintegrative proliferation of essentiality

7.7. Metaaxioeventism

Metaaxioeventistic positions. Metaaxioeventism is a term denoting methodological issues of axioeventism. In considerable simplification, one can assume the division of metaaxioeventistic positions according to the criterion of solving one of the most important problems of metaaxioeventism – the qualification of truthfulness of axioeventistic statements. Thus, the criterion of the logical value of axioeventistic statements determines (Table 7.10.) two positions: *cognitivism* – statements have a logical value (they can be true or false) and *non-cognitivism* – axiological statements do not have a logical value (they cannot be either true or false).

Metaaxioeventistic Cognitivism	Naturalism
	Intuitionism
	Activism
Metaaxioeventistic Noncognitivism	Emotivism
	Prescriptivism

Table 7. 10. Metaaxioeventistic Positions

1. *Metaaxioeventistic Naturalism* - axioeventistic statements contain axioeventistic terms denoting certain 'natural' (empirical) features, i.e., belonging to the reality accessible to empirical knowledge. Therefore: a) Axioeventistic statements have logical value; they can be true or false. b) Axioeventistic statements have a descriptive character and contain axiological terms denoting features belonging to empirical reality. c) Axioeventistic statements can be justified according to the procedure proper to empirical sciences. d) Axioeventistic statements, due to describing empirical reality, logically follow from factual statements (about facts).

2. *Metaaxioeventistic Intuitionism* - axioeventistic statements contain axioeventistic terms denoting 'consequential' features, i.e., those that belong to certain objects by virtue of being derivatives,

consequences of their 'natural' (empirical) features. Therefore: a) Axioeventistic statements have logical value. b) Axioeventistic statements have a descriptive character and contain axiological terms denoting 'consequential' features. c) Axioeventistic statements can be justified according to the procedure proper to empirical sciences. d) Axioeventistic statements, due to describing empirical reality, logically follow from factual statements.

3. *Metaaxioeventistic Activism* - axioeventistic statements contain axioeventistic terms describing certain facts or social phenomena. They are grounded in social reality, and in connection with this, all methodological reservations associated traditionally with this type of reality in the Ontic Universe should be applied: a) Axioeventistic statements have logical value. b) Axioeventistic statements have a descriptive character and contain axiological terms denoting facts or social phenomena. c) Axioeventistic statements can be justified according to the procedure proper to empirical sciences. d) Axioeventistic statements, due to describing empirical reality, logically follow from factual statements.

4. *Metaaxioeventistic Emotivism* - axioeventistic statements contain axioeeventistic terms that either express the emotions of the speaker or are intended to evoke specific emotions in the interlocutor. Therefore: a) Axioeventistic statements do not have logical value. b) Axioeventistic statements do not have a descriptive character. c) Axioeventistic statements cannot be justified according to the procedure proper to empirical sciences. d) Axioeventistic statements do not logically follow from factual statements.

5. *Metaaxioeventistic Prescriptivism* - axioeventistic statements contain axiological terms of a quasi-imperative nature: a) Axioeventistic statements do not have logical value. b) Axioeventistic statements do not have a descriptive character. c) Axioeventistic statements cannot be justified according to the procedure proper to empirical sciences. d) Axioeventistic statements do not logically follow from factual statements.

The issue of the naturalistic fallacy was first sharply articulated by the Scottish philosopher *D. Hume* (1711-1776). He emphasized the validity of reflections only on descriptive ethics, while normative ethics necessarily must remain beyond the scope of scientific inquiry. This is because a logical transition from statements about facts (factual) to statements of an imperative nature is impossible (*no ought from is* - the so-called *Hume's guillotine*). Famous is the passage from his work titled *Treatise of Human Nature* discussing such impossibility:

> In every system of morality, which I have hitherto met with, I have always remark'd, that the author proceeds for some time in the ordinary way of reasoning, and establishes the being of a God, or makes observations concerning human affairs; when of a sudden I am surpriz'd to find, that instead of the usual copulations of propositions, is, and is not, I meet with no proposition that is not connected with an ought, or an ought not. This change is imperceptible; but is, however, of the last consequence. For as this ought, or ought not, expresses some new relation or affirmation, 'tis necessary that it shou'd be observ'd and explain'd; and at the same time that a reason should be given, for what seems altogether inconceivable, how this new relation can be a deduction from others, which are entirely different from it[118]..

Hume's guillotine is a component of the so-called naturalistic fallacy – an unauthorized reduction of axiological sentences to factual sentences. The concept of the naturalistic fallacy itself was introduced into philosophical literature by G.E. Moore in the work *Principia Ethica* [Cambridge at the University Press, 1922]. J. Tanner characterizes this error in the following way:

> Much ink has been spilt over what 'good'; is. The different definitions are too numerous to mention here but some of the common ones include naturalness, happiness, normalness, virtue, and performing one's duty. The philosopher G. E. Moore (1873-1958) argued that it is a mistake to try and define the concept 'good' in terms of some natural property. He called this mistake the naturalistic fallacy. Defining the concept 'good', Moore argued, is as impossible as defining 'yellow';. Yellow is a simple concept. It is simple in that it cannot be defined in terms of any other concept (for instance green). Yellow is yellow, that is as far as one can get when trying to define it. Just so with good. Good cannot be defined or analysed. To do so, to define good as anything other than itself is, therefore, to commit the "naturalistic fallacy"[119].

The naturalistic fallacy refers to the unwarranted reduction of axiological (evaluative or normative) statements to factual statements. Hume's guillotine, therefore, concerns only the impossibility of transitioning from ought-statements to is-statements.

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[118] David Hume (1896), *A Treatise of Human Nature*, edited by L.A. Selby-Bigge, M.A., Oxford Clarendon Press, pp. 244-245.

[119] Julia Tanner, *The Naturalistic Fallacy* [in:] Richmond Journal of Philosophy 13 (Autumn 2006).

There is the so-called standard interpretation of Hume's guillotine, formulated by P.H. Nowell-Smith and R.M. Hare[120]. It looks like this: From the perspective of formal logic, it is impossible for the conclusion of inferences to contain anything more than what is found in the premises. Formal logic is nothing more than a collection of such inference patterns falling under tautological formulas (logical laws and their consequences). Therefore, if the conclusion of an inference is to be a statement about moral duty, it is necessary for one of the premises to be identical to a moral principle (a descriptive statement).

According to G. Hunter[121], there are finally only two sensible interpretations of Hume's guillotine.

According to the *first* - Hume is only saying that it seems entirely unclear how the deduction of '*ough*t' from '*is*' is possible, but - it should be emphasized - it is not inherently unclear. It is true that in previous moral systems, there was usually an unjustified transition from '*is*' to '*ought*'; however, the blame for such a state of affairs should be placed on the creators of those systems, and the burden of incomprehensibility should not be shifted to the nature of the problem itself. Hume, in the Treatise, is trying to demonstrate the possibility of transitioning from 'is' to 'ought.'

According to the *second* - it makes no sense to talk about any 'guillotine', because for Hume: *ought-propositions are identical with certain is-propositions*[122]. Simply put, ought-statements constitute only a specific way of using language; they are a 'paraphrase' of factual statements, although in reality, they have the same meaning as a certain class of factual statements, referring to specific experiences (moral feelings).

Hunter considers only the first interpretation to be correct. In our opinion, the second interpretation is more credible. We believe that the idea of treating statements about duty as a certain subclass of factual statements deserves, in the context of interpreting Hume's thought, considerable attention."

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[120] P.H. Nowell-Smith (1954), *Ethics*, London, s. 36-38. R.M. Hare (1952), *The Language of Morals*, Oxford, pp. 29, 44.

[121] G. Hunter, *Hume on „Is" and „Ought",* Philosophy, XXXVII 1962.

[122] Ibidem: *Hume makes ought-propositions a sub-class of is-propositions, namely is-propositions about the causation of certain sort of feelings. Since he thinks that ought-propositions are logically equivalent to certain is-propositions, it is absurd to attribute to him the view that no is-propositions can by itself entail an ought-propositions, or that no statement of fact can by itself entail a moral judgement.*

8. TIME AND TEMPORAL INTERACTIONS

Time in the Philosophical, Psychological, and Socio-Cultural Dimensions

The philosophical dimension. In philosophy, time has been a subject of interest for thinkers since ancient times. Two fundamental questions were posed then: the first – what kind of reality does time constitute, and the second - what is the essence of time and what are the necessary elements that constitute time, without which it cannot be conceived at all. Depending on the answers to these questions, philosophical positions are divided into: absolutist, relational, and subjectivist:

Absolutist – presupposes that time constitutes a self-existent entity (ens per se), self-contained, universal, and independent of anything else. Advocates of such an understanding of time included Neoplatonists, and in modern times, Galileo Galilei (1564-1642) and Isaac Newton (1643-1727):

> As the order of the parts of time is immutable, so also is the order of the parts of space. Suppose those parts to be moved out of their places, and they will be moved (if the expression may be allowed) out of themselves. For times and spaces are, as it were, the places as well of themselves as of all other things. All things are placed in time as to order of succession; and in space as to order of situation. It is from their essence or nature that they are places; and that the primary places of things should be moveable, is absurd. These are therefore the absolute places; and translations out of those places, are the only absolute motions[123].

According to Newton, time is absolute (unchanging and constant), existing independently of any other physical reality (space, matter, energy processes). The order of time (as well as space) is unchanging, thus determining a certain regularity in the evolution of the Universe. Newton assumed the uniformity of time, meaning that one unit of time is the same everywhere. Regardless of our location in space, time flows uniformly and consistently.

Newton regarded time as an irreversible process that continually flows from the past through the present to the future. His concept of

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[123] Isaac Newton (1846), *The Mathematical Principles of Natural Philosophy*, Published By Daniel Adee, 45 Liberty Street, New York, p. 79.

time aligned with the intuition that time flows only in one direction (*the arrow of time*).

Despite assuming the absoluteness of space and time, Newton did not posit the existence of absolute motion simultaneously. This means that it was not possible to unequivocally determine which body was moving 'actually' at a given moment. He treated motion as a relative concept; motion was described by changes in the position of one body relative to other bodies. Nevertheless, Newton allowed for the existence of certain 'absolute places,' and movements from these places to others are treated as 'only absolute motions.' These absolute places and motions constitute a certain absolute framework within which various relative motions (changes in the positions of objects relative to each other) can be described and measured.

Relational - they refer to the classical formulation of Aristotle found in the fourth book of his Physics:

> But as time is most usually supposed to be motion and a kind of change, we must consider this view. Now the change or movement of each thing is only in the thing which changes or where the thing itself which moves or change may chance to be. But time is present equally everywhere and with all things. Again, change is always faster or slower, whereas time is not; for fast and slow are defined by time—fast is what moves much in a short time, slow what moves little in a long time; but time is not defined by time, by being either a certain amount or a certain kind of it[124].

Aristotle identified time with motion and change. In his understanding, time was connected to processes involving changing and moving entities. Change or motion always occurs in a thing that is changing, or where the thing itself that is moving or changing is located at a given moment. In contrast to motion or change, which occurs in a specific place, according to Aristotle, time is present everywhere and always. It is a universal category that can be found in every place and situation. Aristotle also noted the difference between speed, slowness, and time. Speed and slowness are defined by time, where speed means covering much distance in a short time, and slowness is moving little distance in a long time. Furthermore, time is not defined by itself. In other words, time is not a quantity or

[124] Aristotle, *Physics* (1991), edited by Jonathan Barnes, Princeton University Press, Princeton, N.J. p. 69.

a kind of itself. This is a significant distinction that leads to considerations about the nature of time.

Thus, time is considered a measure of change, expressed in natural language through adverbs like '*earlier*' and '*later*' Time does not exist independently; it always has a reference to certain objects that undergo changes, essentially representing the succession of these changes. In some sense, it could be described as a set of mutual relations between any given events.

Subjectivist perspectives come in two variations: aprioristic and psychological. *The first* is associated with the name of I. Kant (1724-1804), according to whom time, along with space, constitutes an a priori condition for all phenomena, both external to humans and internal. Time is a form of sensory immediacy inherent to all perceiving subjects. Time is not a property of the world itself but of our way of perceiving the world. *The second* variation is associated with the names of Bergson (*intuitionism),* Husserl (*phenomenology*), and Heidegger (*existentialism*). H. Bergson (1859-1941) drew attention to a particular property of the human intellect, namely, that in sensory perception, it eliminates the perception of the process of duration in favour of perceptions of elements forming the structure of perceived objects. In other words, the human intellect tends to perceive reality in spatial categories, fragmenting reality, while, according to Bergson, the constitutive feature of an adequate understanding of reality is temporality, duration. It follows that spatial perception of reality inherently involves a kind of perceptual distortion.

Psychological dimension. Issues such as reaction time to various stimuli, the experience of time by individuals in different situations, the influence of physiological variables on the perception of time, etc., are the subject of interest in the psychology of time. Based on empirical research in this field, many interesting regularities have been observed. For example, there is a correlation between the sense of the passage of time and the level of activity, as when we are engaged in any activity, time seems to pass more quickly than in a state of inactivity. Furthermore, a correlation has been noticed between the passage of time and the type of mental content. The so-called *psychological paradox of time* has also been formulated - the more something prolongs in the present, the more it tends to be shortened in retrospect. The psychological concept of time was masterfully analyzed by T. Mann in *The Magic Mountain*:

> It would not be hard to imagine the existence of creatures, perhaps upon smaller planets planets than ours, practising a miniature time-economy, in whose brief span the brisk tripping gait of our second-hand would posses the tenacious spatial economy of our hand that marks the hours. And, contrariwise, one can conceive of a world so spacious that its time system too has a majestic stride, and the distinctions between "still", "in a little while", "yesterday", "to tomorrow," are, in its economy, possessed of hugely extended significance. That, we say, would be not only conceivable, but viewed in the spirit of a tolerant relativity, and in the light of an already-quoted proverb, might be considered legitimate, sound, even estimable[125].

Thomas Mann suggests that on smaller planets, there might exist beings practicing 'miniature time-economy.' This concept implies that the perception and measurement of time would be different on these smaller planets compared to Earth. Time could pass more quickly or slowly for these hypothetical beings, and their experience of time would be unique in the context of the conditions on their planet. In particular, on these smaller planets, the passage of time could be more condensed or elongated compared to our conventional understanding.

Mann also entertains the opposite scenario, describing a world with vast space, where the distinctions between different temporal concepts such as 'still,' 'in a little while,' 'yesterday,' or 'tomorrow' would have significantly extended significance. The above ideas introduce *relativism*, according to which the perception of time is linked to the size and characteristics of a given planet. Time is not an absolute concept but can vary depending on the features of different worlds.

Historical-cultural dimension: The concept of time has always been an essential element in the worldview of every culture. Even primitive people could distinguish three categories of time: past, present, and future. They used these categories to define and value the boundaries of individual existence, between birth and death, as well as cosmic and social processes.

In the early stages of culture, there was a prevalent awareness of cyclical time reflecting the natural rhythm of cosmic and agrarian processes. This led to the identification of the finite with the infinite and, consequently, a belief in the *cycle of existence*, including

[125] Thomas Mann (1971), *The Magic Mountain*, Secker & Warburg London, p. 546.

individual-subjective existences. Such awareness has persisted within Hindu culture to this day.

With the development of civilization and the needs of science and technology, there emerged the necessity to measure time, dividing it into equal intervals. This led to a new perspective on time as an infinite set of intervals, represented as a straight line. The awareness of linear time emerged, accompanied by the rejection of the belief in the possibility of the repetition of individual conscious existences. This was vividly expressed by Heraclitus of Ephesus, who stated that *one cannot step into the same river twice*.

The Middle Ages were particularly shaped by Christian ideology, emphasizing eternity embodied by God as the central point of reference (time escapes, eternity endures - *tempus fugit, aeternitas manet).* In the Renaissance, there was a rapid reevaluation of the relationship between temporality and eternity. Eternity began to undergo axiological degradation, a state that has persisted into modern times.

Simultaneously, the concept of time, apart from philosophers, who have always been engaged with it, started to preoccupy artists during the Renaissance on a scale unprecedented in the history of art. Baroque and later Romanticism introduced dynamism and temporality in visual arts. Impressionism, in particular, absolutized the moment, aiming to capture the fleeting instant. In literature, time became one of the main characters in works, as evidenced by titles such as Goethe's ‘*Faust*’, Balzac's ‘*The Lizard’*, Wilde's ‘Th*e Picture of Dorian Gray’*, Proust's ‘*In Search of Lost Time’* or the previously mentioned ‘*The Magic Mountain’* by T. Mann.

The issue of time was also a significant topic of research within *cultural anthropology*. The distinguished Polish ethnographer Jan S. Bystroń wrote the following:

> In primitive thinking, time itself is considered a quality, and individual intervals of time have uneven value. Within the span of a year, different seasons are valued differently; festive periods hold a different significance than the time between them. There is a widespread belief in "feral days" that bring misfortune, and it is advised not to initiate any work on such days. Different phases of the moon are assigned different values, and activities undertaken during the full moon carry a different meaning than those

performed during the new moon. Consequently, a variety of economic activities are aligned with lunar phases[126].

In the 'primitive' understanding, time itself is perceived as a distinct quality, and its various intervals are valued in a differentiated manner. In this 'primitive' thinking, time is a complex phenomenon, and individual time intervals possess different meanings and values.

Quality of time - in the 'primitive' understanding, time is not merely an abstract unit of measure but has its own quality. Specific periods of time can be perceived as more or less valuable, influencing how they are treated by the community.

Valuation of different periods of time - different seasons, holiday periods, or moon phases are valued in different ways. Valuation may be associated with cultural practices, religious beliefs, or superstitions.

Belief in ominous days - the concept of ominous days, days bringing misfortune, emphasizes that not every day has the same value or positive significance. Such beliefs influence decisions regarding actions on specific days.

Moon phases as determinants of actions - it was believed that moon phases influence various aspects of life. Economic activities could be adjusted to lunar phases, indicating how people in primitive communities were connected to natural cycles and their impact on time.

This 'primitive' thinking about time reflects strong connections with nature, astronomical cycles, and cultural beliefs. It is undoubtedly a different approach from more sophisticated concepts found in other realms.

Time in Physics

Time in the Special Theory of Relativity. In accordance with the assumptions and postulates of the Special Theory of Relativity (Chapter 3.1.1.), time is interconnected with space and depends on the motion of 'observers' in different reference frames. It is measured

[126] 'Dla myślenia pierwotnego czas sam przez się jest jakością i poszczególne jego odcinki mają nierówną wartość. W obrębie roku poszczególne pory wartościowane są rozmaicie; okresy świąteczne mają inną wartość niż czas pomiędzy nimi; powszechna jest wiara w dni feralne, które przynoszą nieszczęście i w które nie należy żadnej pracy zaczynać. Poszczególne fazy księżyca mają inną wartość, a czynności podjęte w pełnię mają inne znaczenie niż dokonywane na nowiu i w związku z tym cały szereg prac gospodarczych stosuje się do faz księżycowych', Jan Stanisław Bystroń (1947), *Etnografia Polski* (Ethnography of Poland), Warszawa, s. 131.

using (hypothetical) 'clocks' located in individual systems moving at various velocities.

The Special Theory of Relativity has updated philosophical considerations regarding the nature of time, especially concerning two controversial properties: objectivity and relativity.

The objectivity of time can be understood in two ways: as independence from the consciousness of any subject or as independence from the observer, who is a knowing entity.

In the *first* case, in line with a tradition dating back to ancient times, it is considered that physical time exists independently of the subject's consciousness, as it belongs to the nature of reality itself. However, the Special Theory of Relativity posits the existence of the so-called proper time in individual reference frames, which, according to some philosophers, serves as a sufficient argument in favour of its subjective interpretation within this theory. Indeed, '*relativisation*' is not the same as '*subjectivisation*'. The proper time mentioned in the Special Theory of Relativity is relative, meaning it depends on the reference frame and is therefore different for individual reference frames. However, this does not imply any dependence on the knowing subject. Time exists objectively, independently of consciousness.

In the *second* case, the objectivity of time is a property attributed to a reality in which there does not necessarily have to be a reserved place for the knowing subject. In the Special Theory of Relativity, the concept of an 'observer' is indeed employed. Classical mechanics entirely dispensed with this concept, as it conceived of time as something absolute, independent of physical phenomena; the multitude of events in the entire Universe could be located on a common axis. Therefore, it seemed natural that a certain defined class of events could occur simultaneously, at the same moment in time. It was only Einstein who questioned not only the real but also the theoretical possibility of measuring events happening at the same time. This required having clocks that indicate this moment, thus being synchronized. Classical mechanics, however, lacked a reliable method for such synchronization. The simultaneity postulated by classical mechanics can never be verified.

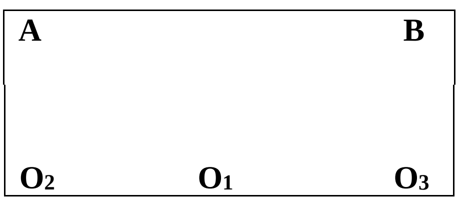
On the contrary, the Special Theory of Relativity relativises time to reference frames and treats it as their '*proper time'*. Concepts such as 'observer' and 'clock' are merely conceptual terms used within the so-called thought experiments. In reality, the relativisation of proper time to a reference frame occurs independently of whether there are any knowing subjects with clocks or whether they exist at all.

The relativity of time in the context of the Special Theory of Relativity implies three things: the dependence of the rate of time passage on the motion of the reference frame, the dependence of time measurements on spatial coordinates, and the dependence of temporal relationships on the observer's position.

The dependence of the rate of time passage on the motion of the reference frame (time dilation) means that time passes more slowly in a moving frame, and the faster the frame moves, the slower time progresses. The fastest passage of time occurs in the object's own reference frame, i.e., in the frame associated with a specific clock whose readings are observed. This phenomenon is not a result of measurement specifics but represents an inherent feature of nature.
In the Special Theory of Relativity, the concept of 'proper time' is introduced, representing the time measured by an object in its own reference frame. It is the time that elapses for the object in its own stationary reference frame. Proper time is constant and unchanged for an object at rest. However, when the object moves at a certain velocity, its proper time passes more slowly as the velocity of its reference frame approaches the speed of light (*time dilation*).

The dependence of time measurements on spatial measurements occurs because the Special Theory of Relativity rejects the absolute, Newtonian time that elapses uniformly throughout the entire universe. It intimately links time with the reference frame, much like the motion or position of bodies. The time at which any event occurs is not the same for all observers, as the difference is determined by the distance of individual observers from the observed event.
Hence, there is a fusion of time and space into a unified whole, into a four-dimensional spacetime continuum where all coordinates are equally important. It becomes evident simultaneously that spatial measurements inevitably entail time measurements.

The dependence of temporal relationships on the observer's position alters the meaning of the traditional concept of the simultaneity of events. There is no such thing as absolute simultaneity; simultaneity of events occurring at a distance from each other is therefore relative and depends on the observer's position. Here is a simple illustration:



Since the speed of light is constant, two different events A and B occurring at a certain distance from each other can be simultaneous for observer O1, event A can be earlier than event B for observer O2, while for observer O3, event A can be later than event B but earlier than event B. It follows that the traditional division of time into past, present, and future is replaced in the Special Theory of Relativity by a division into absolute past, to which there is no return, absolute future, toward which everything moves with inexorable necessity, and relative present. Relative because the multitude of phenomena in the universe cannot be, as it was in classical physics, located on a common axis of universal time. The current state of the universe is relativized to an infinite class of reference frames. This is well illustrated by the so-called *spacetime cone*[127] (Fig. 8.1.).

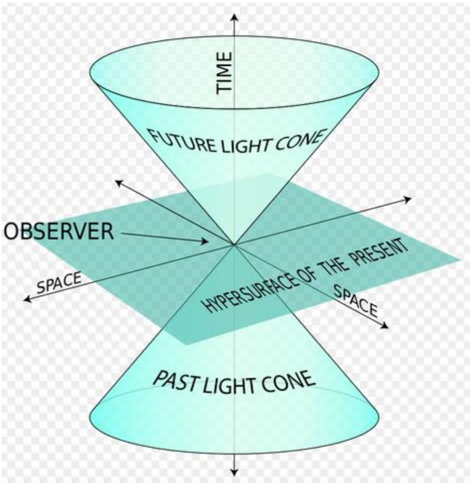


Figure 8.1. Spacetime cone

Lines of time representing objects moving at speeds less than the speed of light arrange themselves in such a way that they do not cross the spacetime cone. This is because the speed of light in a vacuum is the highest speed that any particle with mass can achieve. This means that for objects with nonzero mass, an infinite amount of energy would be needed to accelerate them to a speed equal to or greater than the speed of light. Points on the timelines inside the cone represent the past, present, and future.

The slope of the timelines in the cone causes events that seem simultaneous for one observer in a particular location to be non-simultaneous for another observer in motion relative to the first. The apex of the cone represents events where objects move at the speed

[127] Light cone, https://en.wikipedia.org/wiki/Light_cone

of light. Light-like lines emanating from the apex of the cone are the boundary of the speeds achievable by objects with mass. Points outside the cone are inaccessible for objects with mass because reaching or exceeding the speed of light is impossible according to the Special Theory of Relativity.

Time in General Relativity. The General Theory of Relativity (GTR) is an extension of the Special Theory of Relativity (STR). Unlike STR, which deals with inertial reference frames moving at constant velocity (neglecting gravity), GTR incorporates gravity and the curvature of spacetime due to masses and energy. It even introduces a new concept of gravity, describing it as the curvature of spacetime, which is mathematically formalized by Einstein's field equations. In this context, the understanding of time differs somewhat compared to STR.

The essence of time in General Theory of Relativity (GTR) is deeply intertwined with gravity and the curvature of spacetime. Time is not treated as a separate and independent parameter from space but is regarded as an integral part of spacetime, subject to curvature in the presence of mass and energy. Similar to Special Theory of Relativity (STR), time (accounting for gravity) in GTR can be characterized by two specific properties: objectivity and relativity.

Objectivity of time in GTR refers to the global structure of spacetime where time is integrated with space, and changes in time are associated with the curvature of this structure by mass and energy. Locally, time may vary, but there are certain properties of spacetime that are common to all observers. In general, it can be stated that time is objective in the sense that it is independent of a specific reference frame (and observer); in other words, it is shared among all observers regardless of their motion or location in a gravitational field.

In General Theory of Relativity (GTR), there are two approaches to the concept of time: local time, known as proper time, and cosmic time. *Proper time* (local) is the time measured by a clock moving in a specific gravitational field or accelerated frame. It represents the time of a clock moving at the same point in space as the observer. On the other hand, *cosmic time* is associated with the global structure of spacetime and its dynamics (the evolution of the universe). It is not tied to the motion or gravity of a particular object or region of spacetime but is linked to the overall flow of time on a cosmic scale. In other words, proper time (local) focuses on measuring time for individual objects in a specific location, while cosmic time is associated with the global dynamics of spacetime on a cosmic level.

Therefore, locally, for an observer in a specific location, the time measured by their clock (proper time) is objective in the sense that every clock moving along with the observer will show the same amount of elapsed time for the observer. On the other hand, globally, cosmic time is objective in the sense that it does not depend on specific observers or reference frames in any way, as it relates to the overall dynamics of spacetime (the general evolution of the universe).

Time relativity in General Theory of Relativity (GTR). In Special Theory of Relativity (STR), time relativity implied, among other things, the dependence of the rate of time passage on the motion of the reference frame; time measured in a frame at rest differs from the time measured in a moving frame (time dilation in STR – the faster the frame moves, the slower time flows within it).

In GTR, it is argued that objects (systems) move not due to the action of gravitational force, but under the influence of the curvature of spacetime created by a specific distribution of mass and energy (gravity is nothing more than the curvature of spacetime). Objects move along curves that are geodesic lines in the curved spacetime (the shortest trajectories). In places with greater mass density (near massive objects), spacetime is more curved. The closer the distance to a massive object, the more curved the spacetime, and consequently, time passes more slowly there compared to regions with less curvature. This phenomenon is known as gravitational time dilation.

In short, *gravitational time dilation* in General Theory of Relativity (GTR) is a phenomenon in which an observer in a strong gravitational field (measuring time) moves more slowly compared to an observer in a field with lower gravitational potential (measuring time). In other words, the greater the gravity (curvature of spacetime), the slower time flows. In regions with higher gravity, such as those around massive objects with high density, time measured by clocks moving in that region "flows more slowly" compared to time measured in regions with weaker gravitational fields. This phenomenon arises because mass-energy curves spacetime, and clocks in regions of higher gravity experience this curvature.

*Past, present, and future in General Theory of Relativit*y (GTR): The curvature of spacetime due to the distribution of mass and energy influences the ‘experience’ of time by systems in a linear aspect: past – present – future. Simultaneously, there is a phenomenon that can be termed the relativisation of simultaneity. It means that different observers moving with different velocities may have different experiences of the simultaneity of events. This is conditioned by the curvature of spacetime by mass and energy. The gravitational field curves spacetime, and the motion of objects in this curved spacetime introduces effects that impact the varied experiences of the simultaneity of events for different observers.

Past in GTR is associated with regions of spacetime that are curved in such a way that backward-directed timelines lead to specific events. In areas with higher mass density, where spacetime is more curved, backward-directed timelines may converge around a particular region, forming an area that we interpret as the past.

Present in GTR is related to regions of spacetime where timelines are perceived as "current" events. An area temporarily free from significant spacetime curvature can be interpreted as the present, where events are considered simultaneous in a certain sense.

Future in GTR is linked to regions of spacetime where forward-directed timelines lead to potential events. In areas with lower mass density, where spacetime is less curved, forward-directed timelines can be interpreted as an area representing the future.

Time in quantum physics. The quantum concept of time posits that time is not treated as a continuous and independent entity from space but is rather connected to quantum phenomena in physics. According to this concept, time is understood as one of many quantum variables that constitute the spacetime structure of the universe. In accordance with the principles of quantum mechanics, certain pairs of quantum variables, such as position and momentum, cannot be precisely determined simultaneously. Instead, a quantum variable may take on various values with certain probabilities. Similarly, in the quantum concept of time, time can be treated as a quantum variable that assumes different values with certain probabilities. Furthermore, in quantum field theory, time functions as one of the time-space coordinates in the four-dimensional spacetime structure. In this concept, space and time are intertwined, and each point in spacetime describes the quantum state of a physical system.

Similar to the overall framework of quantum mechanics, there are at least two different approaches to describing time in the quantum concept of time. One of them is the formalism of W. Heisenberg, and the other is the formalism of P. Dirac.

The Heisenberg formalism is based on observable operators, which represent physical quantities measurable in experiments. Time is treated as a parameter that is part of observable operators. For example, the energy operator describes the energy state of a system at a given time, while the momentum operator describes the motion state of the system at that time. In the Heisenberg formalism, there is no unique trajectory of objects in time; instead, there are only probabilities of their occurrence in specific states. Consequently, time is treated as a *random variable* that can be described using a probability distribution function.

Another approach to describing time in quantum physics is the *formalism of P. Dirac*, where time is treated as an *independent variable*, and the state of a system is described by a wave function that evolves over time according to the Schrödinger equation. According to this theory, quantum particles do not have a definite position and momentum at a given time but exist in a superposition of states, leading to phenomena such as quantum tunnelling and quantum entanglement. Treating time as an independent variable facilitates writing equations of motion and solving problems related to the analysis of the time evolution of quantum systems.

Axioeventistic Approach

It is accepted that there are three types of time: *objective* (cosmic), *subjective* (psychological), and *totaltime* (eternalism).

Objective time[128] (cosmic) - an infinite sequence of distances between any events within the Ontic Universe:

> **<u>Def. 8.1.</u> *Temporal interaction* is an ontic (informational, eventistic, axiocreational) interaction between any Relatively Isolated Systems in terms of the irreversibility of ontic interactions (predecessor-successor) or their reversibility (successor-predecessor).**

> **<u>Def. 8.2.</u> *Objective time* (cosmic) is an infinite sequence of distances between predecessors and successors of temporal interactions (irreversible interactions) or between their successors and predecessors (reversible interactions). Predecessors are referred to as the past, and successors as the future. The present is the sum of the past and the future, i.e., the sum of predecessors and successors of ontic interactions. The sequence of interactions is recorded in the so-called ontic memory.**

[128] The time effects discussed in physics (relativistic and quantum) are analyzed within physics using physical methods; however, they do not hold significant relevance for the axioeventistic understanding of time.

Reversibility as well as irreversibility of ontic interactions can progress in both the direction of tempentropy (indeterminacy) and temponegentropy (determinacy). However, if a given process proceeds from predecessor to successor in the direction of temponegentropy, then the reverse process, from successor to predecessor, will naturally progress from temponegentropy to tempentropy. Conversely, the final tempentropy-driven process implies reversibility in the direction of temponegentropy.

The infinite sequence of distances is associated with the so-called *ontic memor*y, which means nothing more than the existence of a set of information generated during any axioeventistic interactions between Relatively Isolated Systems in the Ontic Universe.

One of the more well-known examples indicating that the laws of physics operate independently of the direction of time flow is a video depicting billiard balls colliding and scattering. Whether the video is played forward or backward, the balls behave the same way, indicating that the laws of physics operate similarly in both temporal directions. Another example is the phenomenon of free fall under gravity. When we observe this phenomenon in reverse, we see the object moving upward instead of falling downward, but the laws of physics, such as the law of gravity, still operate the same way. Other examples include the diffusion of particles in a gas, the propagation of sound waves, as well as chemical reactions that occur the same way regardless of the direction of time flow.

In the case of irreversible processes, the direction of interaction becomes unequivocally determined. However, the unresolved issue remains whether there are any irreversible processes in the Ontic Universe (particularly, in the natural reality) at all. There is no room for speculation here; the resolution lies solely in scientific empirical experiments.

In the light of modern physics, there are phenomena that, at the current stage of scientific development, are considered as events not subject to time reversal (the arrow of time applies). Among them is the phenomenon of electromagnetic waves; they transfer energy from one place to another. An increase in their energy leads to a shortening of the wavelength, which in turn results in an increase in frequency. Experiments indicate that electromagnetic waves always move in one direction of time - from the past to the future. Similarly, in the phenomenon of quantum mechanics, such as particle decay, it occurs only in one direction. Particles can decay, but they can never come back together as a whole. The arrow of time in this case indicates that time has only one direction, from the past to the future.

Subjective time (psychological) - a finite sequence of events reconstructed (past) or anticipated (future) by a conscious subject from a distinguished position (present).

> **Def. 8.3.** ***Quasi-temporal interaction*** **is an interaction involving the reconstruction of predecessors of the present or the anticipation of successors of the present by any conscious subject.**

> **Def. 8.4.** ***Subjective time*** **(psychological) is understood retrospectively as the reconstruction by a conscious subject of certain events (past) or prospectively - as the anticipation of certain events (future). The present is merely a minimal, unstable point between retrospection and anticipation performed by the conscious subject.**

Subjective time thus refers to the social (including individual and historical) experience of time. On the one hand, time can be perceived differently depending on the experiencer. On the other hand, there are certain social and historical frameworks that position the flow of time within them towards the direction from past to future (psychological arrow of time). Subjective time is associated, on the one hand, with the memory of the past (including individual and historical), and on the other hand, with a more or less adequate extrapolation of the future.

Subjective time, like objective time, is subject to characteristics related to determinacy and indeterminacy:

> **Thesis 8.1. The greater the temponegentropy, that is, the greater determinacy regarding the nature of predecessors in temporal interaction, the more adequate the reconstruction of the past. The greater the tempentropy, that is, the greater indeterminacy regarding the nature of successors in temporal interaction, the less adequate the prediction of the future.**

It is possible to reconstruct any events in the chosen domain of the Ontic Universe, such as the event of the formation of the Solar System, the origin of life on Earth, the emergence of humanity, or historical events. Similarly, the situation is with forecasting. Each forecast consists of a sequence of predictive statements, which generally have a similar structural pattern: a predictive functor like 'I predict that...' or 'I speculate that...', and a sentence describing the future. Of course, predictive functors do not have to be explicitly stated.

Totaltime (eternalism) is the concept acknowledging that the past, present, and future share the same ontological status, meaning that the past does not pass away, the present continually does not change, and the future exists not only as something yet to come:

> **Def. 8.5.** ***Total-time*** **(eternalism) - the concept of eternalism is a philosophical position according to which there exists a single coherent and simultaneous entity (the past, present, and future are indistinguishable), in which dynamism is treated as an illusion, resulting from 'ontic memory' (objective time), occurring within one static reality.**

In a simplified manner, it can be said that according to eternalism, our perception of time is similar to what happens when watching a movie - events that have already occurred are already recorded on the film, and those that have not yet happened will be recorded in the future. However, from the perspective of the film reel, these events exist simultaneously and do not change over time.

Time is merely a one-dimensional structure through which various events unfold, existing independently of the perception of any conscious subject. The dynamism of reality, being an illusion generated by 'objective memory,' has nothing to do with illusions dependent on the perception of a conscious subject. Evolution, as a process, would not involve transitioning from non-existence to existence or moving through time. Instead, all stages of development and change, from beginning to end, exist simultaneously. In this context, there is no moment when living organisms evolve from one form to another because these forms are perpetually present in the collective picture of time.

This is precisely what distinguishes eternalism from presentism, as the latter assumes that time is linked to the experience and perspective of the individual, and is not a unified temporal stream that exists independently of the observer. According to presentism, the present is closely dependent on the perceiving subject. Presentism is a philosophical concept of time that asserts that only the present is real, and the past and future exist only as abstractions or potential possibilities. This means that each observer, each individual, experiences the present subjectively according to their viewpoint and current perception.

One of the most prominent precursors of presentism is considered to be St. Augustine:

> [XX.] 26. What now is clear and plain is, that neither things to come nor past are. Nor is it properly said, " there be three times, past, present, and to come:" yet perchance it might be properly said, "there be three times; a present things past, a present of things present, and a present of this future." For these three do exist in some sort, in the soul, but other where do I not see them; present of thing past, memory; present of things present, sight; present of things future, expectation. If thus we be permitted to speak, I see three times, and I confess there are three. Let it be said too," there be three times, past, present, and to come:" in our incorrect way. See, I object not, nor gainsay, no find fault, if what is so said be but understood, that neither what is to be, now is, nor what is past. For but few things are there, which we speak properly, most things improperly; still the things intended are understood[129].

Augustine addresses the issue of three times: past, present, and future. However, rather than treating them as separate 'times' in a traditional manner, Augustine emphasizes that they exist in the soul in a specific way. Presentness of past things (*memory*) - in our soul, there is something Augustine calls the presentness of past things, which can be associated with memory. It is through memory that we can discover and understand what has already happened. Presentness of present things (*sight*) - the second form of presentness is related to present things, which Augustine calls sight. It refers to what is currently available for us to see and understand. Presentness of future things (*expectation*) - the third form of presentness is expectation, which concerns future things. Through expectation, we can anticipate what is to come.

Augustine pointed out that God, as the Creator of time, is not bound by its passing. At the same time, he recognized that for creatures like humans, time is experienced sequentially. However, these three '*times*' exist in our soul, not necessarily as distinct external categories. This reflection leads him to contemplate the nature of time as something deeper than a simple sequence of past, present, and future.

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[129] Augustine of Hippo, *The Confessions of S. Augustine*, Oxford, John Henry Parker; J.G. and F. Rivington, Lodon, MDCCCXXXVIII, p. 239.

The issue of time travel. Currently, according to our scientific knowledge, time travel, as portrayed in *science fiction* literature, is not possible. The concept of time travel is a fascinating topic in theoretical physics, but most proposals in this area are speculative and lack experimental confirmation.

> However, the concentrations of matter-energy necessary to bend time backward are so vast that general relativity breaks down and quantum corrections begin to dominate over relativity. Thus the final verdict on time travel cannot be answered within the framework of Einstein's equations, which break down in extremely large gravitational fields, where we expect quantum theory to become dominant
>
> This is where the hyperspace theory can settle the question. Because both quantum theory and Einstein's theory of gravity are united in ten-dimensional space, we expect that the question of time travel will be settled decisively by the hyperspace theory. As in the case of wormholes and dimensional windows, the final chapter will be written when we incorporate the full power of the hyperspace theory[130].

In the above excerpt from '*Hyperspace: A Scientific Odyssey Through Parallel Universes, Time Warp*' Michio Kaku discusses the issue of time travel, highlighting the challenges and limitations of Albert Einstein's general theory of relativity in the context of very large gravitational fields. He emphasizes that in such areas, the concentration of matter-energy is so immense that the general theory of relativity may fall short, with quantum corrections potentially taking precedence.

The author suggests that the theory of hyperspace could be crucial in solving the puzzle of time travel. He points out that quantum theory and Einstein's theory of gravity might be unified in a ten-dimensional space, opening the possibility for a definitive resolution to the question of time travel.

An alternative perspective holds:

> This might be impossible. Conventional wisdom has it that true time travel must be impossible, because of the paradoxes involved, like the one where you go back in time and kill your grandfather before your own father has been conceived. On the other hand, at the quantum level particles

[130] Michio Kaku (1994), *Hyperspace. A Scientific Odyssey Through Parallel Universes, Time Warps,* And The 10th Dimension, Oxford University Press. p. 234.

> seem to be involved in time travel all the "time," and Frank Tipler has shown that the equations of general relativity permit time travel. It is possible to conceive of a kind of genuine travel forward and backward in time that does not permit paradoxes, and such a form of time travel depends on the reality of alternative universes (…) All possible things do happen, in some branch of reality. The key to entering those possible realities is not travel sideways in time, but backward and then forward into another branch[131].

The above excerpt pertains to considerations regarding paradoxes associated with time travel, such as the famous 'grandfather paradox,' which may arise from going back to the past and potentially influencing one's own timeline. The author also mentions various approaches to the issue of time travel within theoretical physics. There is a reference to certain quantum-level phenomena that seem to be involved in time travel. It is often argued that the equations of general relativity allow for the theoretical possibility of time travel. Additionally, the concept of alternate realities or parallel universes is pointed out as a potential solution to the paradoxes associated with time travel. This idea posits the existence of multiple parallel universes where different decisions and events lead to diverse and distinct scenarios.

In *axioeventism*, the primary emphasis lies in recognizing that the concept of '*time travel*' itself is flawed; one should use the term '*time and space travel* (spacetime travel)'. In this case, it would be fitting to acknowledge the achievements of the General Theory of Relativity. Movement in time is indeed closely tied to movement in space. What we call 'time travel' in the context of the general theory of relativity, also signifies a change in physical space. A change in one dimension (*time*) simultaneously leads to a change in the other dimension (*space*). According to this approach, time travel always includes an aspect of moving through space. When an object travels in time, it concurrently traverses various points in space.

This would be particularly significant in reference to the '*time travel*' of a conscious entity; shifts in time are inherently linked to an awareness of the alteration of all spacetime coordinates. Axioeventism, by introducing three understandings of time (objective, subjective, and totaltime), does not perceive fundamental difficulties in accepting time and spacetime travel, especially as the concept of *eternalism* provides a solid framework for such

[131] John Gribbin, *In Search of Schrodinger's Cat. Quantum Physics and Reality*, Black Swan edition published 1991, pp. 248-250.

acceptance. Nevertheless, the real stage for such journeys appears to remain *objective time*, and manipulating it seems achievable solely through the advancements of theoretical physics and their realization in technical devices.

9. AXIOEVENTISTIC CONCEPT OF MAN

9.1. Selected Philosophical Concepts

The psychic plane constitutes the subject of specialized sciences, especially psychology in relation to individuals meeting the norm of the psyche, or psychiatry in relation to individuals with psychological deviations. Something entirely different is *philosophical anthropology,* or the philosophy of man, which seeks to define man both in the species dimension (man as a species) and in the individual dimension (man as an individual). Broadly speaking, its object of study is man in various aspects of existence, similar to natural anthropology or cultural anthropology. However, it differs from them in terms of research methods; natural anthropology and cultural anthropology are sciences about humans practiced using empirical research methods such as observation, comparative analysis, or morphology, while philosophical anthropology is limited to philosophical methods (often speculative). This, of course, does not prevent it from benefiting from the achievements of specialized sciences.

Philosophical anthropology, as one of the disciplines of philosophy, inherits all the merits and demerits of philosophy as a particular field of knowledge, including, for example, the indeterminacy of the scope of interests. This results, among other things, in the fact that the philosophy of man depends to a large extent on the way of understanding (conception) of philosophy itself; different answers to its fundamental questions can be expected, for instance, within the phenomenological framework and different within the analytical conception of philosophy.

However, before the fundamental issues of philosophical anthropology are positively formulated, it will be beneficial to be aware of the history of questions about the essence of man. The questions posed by philosophers in different periods of the development of philosophical thought about man can be formulated as follows:

Ancient times - Is the nature of man a part of the cosmos, a divine creation, or the result of autonomous human activity?

Medieval period - What is the actual place of man in the world, and what is his calling?

Renaissance - Does human life truly correspond to his nature, or does it decidedly deviate from it?

17th Century - Does the meaning of human existence lie in the order of the existing world, or does man find it in the world that he himself creates?

18th Century - What is 'natural' and unchangeable in human nature, and what is 'artificial' and variable?

19th Century - Is man entirely subservient to history, or does he also shape it?

Reflection on the essence of man, on who man is, has been pursued to a greater or lesser extent since the beginning of philosophy. However, it was only with the name of *Max Scheler* (1874-1928) that the delineation of a separate discipline within philosophy - philosophical anthropology, with the exclusive object of its interest being the problem of man - became associated. Max Scheler sets the following tasks for it:

> The three dominant insights that Scheler wishes to unify are (1) the human being as "tool maker" (homo faber), the insight of Darwinian evolution and science, (2) the human being as rational animal, the insight directing the ancient Greek worldview, and (3) the human being as child of God, the insight of the Judeo-Christian worldview. Each insight, for Scheler, reveals a peculiar aspect of the human being. The problem is that no one has yet shown how these insights are united to form a singular whole, the unity that is the human being[132].

One can create various catalogs of fundamental questions in philosophical anthropology and then contemplate how to systematize the diversity of concepts about man, where attempts are made to answer them. An exemplary catalog of questions looks like this:

1. Who is man - what is his essence, and what constitutes the specificity of human nature?
2. What is the ontological structure of man - the essential constitution of man?
3. What is the place of man in the world in relation to supernatural and natural reality?
4. What is the metaphysical genesis of man, and does it make sense at all?
5. What determines human behaviour, especially what motivates him to certain actions?

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[132] Zachary Davis, Anthony Steinbock [2018], *Max Scheler*, https://plato.stanford.edu/entries/scheler/#PhiAntMet

6. What is the meaning of human life - does it have some heteronomous purpose and destiny, or not?

The above catalog of questions will serve as the basis for conducting a classification of concepts about man, contained in the following Table 9.1. However, not all questions will be taken into account due to the selectively essential nature of this study.

Criterion	**Selected Concepts**	**Main Representatives**
Human Nature	dzoon politikon	Aristotle
	homo religiosus	St. Augustine
	homo oeconomicus	A. Smith
	homo faber	K. Marks
	homo ludens	J. Huizinga
	Materialistic	Democritus, la Mettrie
Structural Being of Human	spiritualistic	Plato, Hegel
	hylemorphic	Aristotle, St. Thomas, Descartes, Kant
Human's Place in the Ontic Universe	relationship to transcendencje	Plato, St. Augustine, St. Thomas
	relationship to nature	T. Hobbes, Helvetiuss
	relationship to broadly understood structures	Levi-Strauss, J. Piaget
	relationship to oother people	M. Buber, J. Tischner
	realtionship to oneself	Socrates, K. Jaspers

Table 9.1. Selected Concepts of Human in Philosophical Anthropology

***Human Nature*.**

In the history of philosophy, two basic methodological approaches can be observed in considering human nature. The *first* is oriented towards discovering a certain fixed set of characteristics inherent to all specimens of Homo sapiens, and the *second* emphasizes a series of social and historical conditions that, in some proportion, combined with species characteristics, determine human nature. The extreme position associated with the second approach is represented by the Spanish philosopher *Ortega y Gasset* (1883-1955), who, in reference to the Hegelian concept of man as *homo historicus*, even states that man has no nature, only a history.

In fact, most philosophers addressing fundamental issues concerning humans have some concept of human nature. In Table 3.1, only a few of them are presented, guided by a completely arbitrary criterion, considering concise, almost symbolic formulations that, nevertheless, synthetically convey essential content:

1. *Dzoon politikon* (Latin: homo politicus) - according to Aristotle, man is a political animal, meaning that due to individual limitations - an essence created to live in the state, as only the state can provide the individual with conditions for a happy life.

2. *Homo religiosus* - man is a being called by God to immortality and salvation; what he is entirely transcends him, and only through participation in God's plan can the human individual find authenticity.

3 *Homo oeconomicus* - man, in his actions, is mainly guided by the pursuit of maximizing personal benefits; this concept, deriving from classical utilitarianism and liberalism, is based on ‘healthy selfishness’ according to which care for one's material benefits indirectly contributes to the overall prosperity of society.

4. *Homo faber* - man is a being that uses tools, but this not only means that man creates tools for his work; it simultaneously indicates that these tools transform man.

5. *Homo ludens* - man is a creature that plays. Of course, this formulation should not be treated as a description of a social fact but as a constitutive feature of human nature, co-creating humanity along with other characteristics.

Structural Being of Human.

1. *Materialistic Concepts of Human*. One of the first thinkers to develop his views in the spirit of materialism was *Democritus of Abdera* (460 BC). According to him, a human being constitutes a small world (microcosm) that reflects the universe (macrocosm). The soul, to the same extent as the body, is composed of atoms. The difference between them is solely related to the shape of the atoms

composing them; the body is constructed from non-shaped atoms, while the soul is composed of round atoms.

2. *Spiritualistic Concepts of Human. Plato* describes a human as a soul using a body. Originally, the soul existed without a body, and the incarnation, i.e., the union of the soul with the body, is considered a consequence of the moral decline of the soul. As a result, the body became a 'prison for the soul,' which should strive to rid itself of it in order to regain authentic existence in the world of ideas and contemplate truth, goodness, and beauty there: As long as - we read in *Phaedo* – 'we have a body and our soul is united with such great evil, in the world, we can never fully attain and possess what we desire. And we say that this is truth'. The most effective path to self-liberation from the bonds of corporeality involves attaining truth through the study of philosophy.

3. *Hylemorphic Concepts of Human*. *Aristotle* advocated for the psychophysical unity of man; a human being constitutes a combination of a material body (*hyle*) and an immaterial soul-form (*morphe*). Both elements are equally important and constitutive for a human being. In contrast to Plato, for whom death meant the ultimate liberation of man from the bonds of corporeality, for Aristotle, it was essentially synonymous with his total destruction. We say 'essentially' because strictly speaking, death should be understood - in accordance with the principles of Aristotelian metaphysics - as a substantial change occurring in man, whereby this change destroys the complexity of constituent components, and as a result, man ceases to be what constitutes his essence, ceasing to be himself.

Human's Place in the Universe.

It can be determined by the relationships of a human being to transcendence, nature, structure understood as a certain whole, other people, and the relationship to oneself.

1. *Relationship to Transcendence*. The Middle Ages developed the concept of a person as a human shaped in the image of God. The very notion of a person (Greek: *prosopon*) originated among the ancient Greeks to denote a theatrical mask used by actors during performances. Later, the term 'person' was applied to heroes and famous individuals. The Christian thought, in connection with Christological disputes, adapted it for philosophical use. *Boethius* (480-524) formulated the classical definition of a person: a person is an individual substance of a rational nature (*persona est naturae rationabilis individua substantia*). This definition was later employed by Thomas Aquinas in his theory of man, which gave rise to the

philosophy of the person, extending to its modern version known as *personalism*[133].

According to *Thomas Aquinas*, man is the crown of all things, a composite of body (matter) and immortal soul (act of the body - corporis actus). God creates an individual soul each time and embeds it into the human body. Thus, man exists in two dimensions: as a being dependent on body-matter (*individual man)* and as a being constituted by the mind and will (*person*). Being a person-individual, man most fully and in the most perfect way expresses himself in relation to God - a transcendent being, manifesting his love, faith, and hope towards Him (the so-called theological virtues).

2. *Relationship to Nature*. *Thomas Hobbes* (1588-1679) was an advocate of the materialistic concept of man. The body and soul are composed of matter, with the soul being made of very subtle, imperceptible matter. Such a view of man aligns with the fundamental premise of Hobbes' philosophy, stating that the entire world, regardless of ontic levels, is built of matter in motion. However, Hobbes' program in philosophical anthropology aimed not only to describe man but also to answer the question of why man is the way he is. The answer to this question became possible through his method of *detecting infinitely small tendencies*. This method involves a meticulous analysis of as many cases as possible, which, when summed up historically, led to the permanent growth of certain phenomena and the intensification of selected characteristics, ultimately resulting in the shaping of the currently observed beings. Based on this method, Hobbes discovered that man is a *speaking being*; man evolved over centuries through speech, and therefore through mutual communication among people using established signs for things. The development of speech, in turn, stimulated the development of reason.

Simultaneously, Hobbes provided yet another answer to the question he posed: why is man the way he is? This second answer did not negate the significance of the first, but rather, by utilizing it, opened entirely new horizons. No one before him - and until Hegel, no one after him - expressed man in this way, as a being that creates itself through social objectification. Hobbes assumed that originally, man existed in a *state of nature* characterized by the following traits:

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[133] It is worth noting the dual sense of the concept of the philosophy of person. At times, it is used to denote the philosophy of man (philosophical anthropology), i.e., the expressions '*philosophy of man'* and 'philosophy of person' are sometimes used interchangeably. At other times, it refers to a human-person - in a spiritual perspective, contrasting with a human-individual - in an empirical perspective. In this case, it is a narrower sense of the '*philosophy of person'*, denoting a specific philosophical direction called *personalism*.

rivalry, distrust, and the desire for fame. Consequently, there was a *war of all against all*. Therefore, by nature, man is an aggressive and antisocial being (*homo homini lupus est*) ; according to Hobbes, man became capable of social life not by his nature but through education.

3. *Relationship to Structure*. In structuralism, the human individual is defined by certain universal structures discovered through logic, linguistics, sociology, and psychology. For example, in the thought of *C. Levi-Strauss*, the role of the individual is reduced to an impersonal ‘mind’ in which the universal principles of culture are embodied. This "mind" constitutes a timeless, prereflexive, and necessary structure. Levi-Strauss, drawing on Freudian psychoanalysis, attempted to explain consciousness through the subconscious, reflective thought through non-reflective, 'unfamiliar' thought. He was convinced that various forms of social life should be recognized as essentially having the same nature, as systems of behaviour, each being a projection of universal laws governing the unconscious activity of the mind onto the plane of conscious and social thought.

By questioning the specificity and autonomy of the individual, he also questions the meaning of speaking about identity and the permanence of the inner '*self*', something commonly referred to as the individual human subject. The structuralist *J. Lacan*, instead of the term 'self', which suggests an individual subject, proposes using the impersonal formula ‘*one speaks’*. On the other hand, another structuralist, *M. Foucault*, predicts the future disappearance of the very idea of the human individual and its replacement with the idea of man as an epiphenomenon of a universal structure.

4. *Relationship to Other People*. The world of human beings is primarily a stage for encounters and conversations between people. The philosophical trend that places dialogue between two or more individuals at the centre of its interests is called the philosophy of encounter, the philosophy of dialogue, or dialogics. Key figures in this trend include *M. Buber*, *F. Rosenzweig*, *G. Marcel*, and *E. Levinas*. M. Buber (1878-1965), in his most famous work titled ‘*Ich und Du*’ (I and Thou), establishes two relationships with what surrounds us: the *'I-It'* relationship and the *'I-Thou'* relationship. The first signifies that we treat an object or person objectively, as something that is not essential to our lives, something we can discard after use. On the other hand, the '*I-Thou*' relationship occurs when we treat an object or person subjectively, as something significant to us, where we perceive the presence of God and experience it as authentic value. It is through engaging in such relationships with the people

and objects around us that our humanity is conditioned; it is only through such relationships that we become truly human.

5. *Relationship to oneself*. The name of Socrates (469-399) is associated with a turn in the practice of philosophy (known as the Socratic turn or anthropocentric turn) that focuses on placing the issue of humanity at the centre of philosophical concerns. This involves introducing the principle that individuals, through their own reason, determine what is good and what is evil, as this is what matters most, rather than contemplating the nature of the world, its composition, and its ultimate purpose. The primary emphasis becomes the exploration and understanding of oneself; Socrates endeavours to persuade each person to prioritize the care of oneself before attending to any other matters, aspiring to become the best and wisest version of oneself.

Systems of views regarding humans can also be divided according to the criterion of belonging to specific fields of knowledge. Thus, one can speak of philosophical, sociological, or psychological concepts. This division is not exclusive, not only because these fields of knowledge are genetically derived from philosophy but also because the scopes of their research subjects partially overlap with each other. *Sociologism*, especially that of E. Durkheim, deserves particular attention.

According to Durkheim, a human being is immersed in history, aware of both their past and future. Humans also create culture—all thanks to having a specific nature and participating in social life. Proponents of sociologism argue that an individual of the Homo sapiens species is not born human; rather, they fully acquire their humanity by living in society. However, this is not true, contradicting the science of heredity, which asserts the transmission of the species' nature from generation to generation. A person is born human only in the sense that they possess the human species' nature; nevertheless, to reach a certain level of civilization, they must develop within a human community that imparts a specific civilizational heritage to them.

There are indeed documented cases of 'wild humans,' i.e., children growing up outside of a social environment, e.g., Kasper Hauser, who lived in the 19th century and did not see another person for 16 years; an Icelandic boy raised among sheep; 'wolf children' from India. These children used tools, a characteristic of humans, and employed sounds to denote objects or situations, which can be considered the beginnings of language. Thus, even 'wild children' possess within their biopsychology the capacity to independently develop human-specific traits. However, only through collective life can a human being fully unfold their humanity. Interestingly, Emile Durkheim regards society as a real entity superimposed over individuals. Manifestations of this social entity as a distinct reality include, among other things, *religion* and *morality*.

9.2. Axioeventistic Concept of Man

The axioeventistic philosophy of man consists of two parts: the first concerns the individual as a person, and the second regards the individual as a social being forming specific social communities. Individuals and social communities possess certain *constitutive features*, which, considering the world of values, can be treated as so-called *teleological values*, representing the goal of realization on the one hand for each human individual and on the other hand for each social community. They can be either *positive*, lying on the line of essential proliferation of integrative nature, or *negative* – lying on the line of essential proliferation of disintegrative nature.

In the individual aspect, unlike other living beings, a human being is a self-aware and rational subject. For this reason, they should adhere to the so-called *Axioeventistic Postulate*:

> **Def. 9.1.** ***The Axioeventistic Postulate*** **states that a human being (respectively, as an individual and as a member of a collective) should strive to the maximum degree for the realization of positive values (essential proliferation of integrative nature) and avoid to the maximum degree the realization of negative values (essential proliferation of disintegrative nature).**

In Table 9.2, constitutive features (values) of both the individual and the social collective will be specified and briefly discussed, particularly focusing on negative values as they represent the opposite of positive ones.

Individual	Possitive	Life, Reasonableness, Dignity of the Person, Self-realization (perfection, happiness, pleasure)
	Negative	Death, Unreasonableness, Denial of the Dignity of the Person, Self-realization (imperfection, unhappiness, sorrow)
Social	Positive	Justice, Freedom, Security

Collective	Negative	Injustice, Enslavement, Threats

Table 9.2. Constitutive Features of the Individual and the Social Collective

Philosophy of Man as an Individual. The constitutive features of the individual human being include the following: life, rationality, dignity of the person, and self-realization.

1. *L i f e* , understood in a biological sense, is generally considered in terms of functional criteria (functions associated with living organisms, including heterosexual reproduction) or structural criteria (specific, highly organized dynamic structure). The biological (as well as psychological) existence of the individual is characterized by a set of processes, some of which are positive for them, while others are negative. The balance between these determines what is referred to as the *quality of life.* The degree of quality of life can be expressed in axioeventistic terms as the current and potential proliferation of all components building the quality of life towards either integrative (*positive values*) or disintegrative (*negative values*) directions.

The life of every human being in itself, especially human life, constitutes a basic and *fundamental value* in the sense that it serves as a necessary condition for the existence and continuity of all other values associated with each individual (particularly the human individual). However, individual life should not be equated with an *absolute value*, one that must be respected and protected at all times and in all circumstances. The moral and legal norm "do not kill" is and should be derived from the fundamental value of life, rather than from an absolute value of life. This implies the demand to relativise this norm to the current and potential quality of life for each individual human being and to the collective set of other individuals (social environment).

In the above context, it becomes evident that there may be cases (restrictively determined in specific situations) in which the low current or potential *quality of life* for an individual, as well as the social environment (euthanasia, abortion), or defence against aggression (just war, necessary defence, capital punishment) suspends the moral and legal norm of '*do not kill*'.

2. *H u m a n   r e a s o n a b l e n e s s* as an individual is understood by axioeventism as an activity unfolding in four dimensions: cognitive (*cognitive reason*), axiological (*axiological reason*), contemplative (*contemplative reason*), and social (*social reason*). Accordingly, four types can be distinguished, collectively

constituting the characteristics of a human being: homo cogitans, virtuensis, contemplans, and societus (Table 9.3.)

Criterion	**Coginitive Reason**	**Axiological Reason**	**Contemplative Reason**	**Social Reason**
Homo Cogitans	COGNITION	-	-	-
Homo Virtuensis	-	EVALUATION	-	-
Homo Contemplans	-	-	CONTEMPLATION	-
Homo Societus	-	-	-	COOPERATION

Table 9.3. Concepts of Human and Reason

*Homo cogitan*s - the activity of *cognitive reason* enables humans (as individuals and members of a collective) to engage in versatile physical exploration (understanding and transforming the physical environment) as well as purely intellectual exploration. *Cognitive reason* pertains to the cognitive and thinking abilities that allow us to comprehend, process, and interpret information. It is a comprehensive set of intellectual skills that enable us to think, problem-solve, remember, learn, communicate, and make decisions. For these reasons, it can be said that the characteristic of reasonableness constitutes the essence of a human being as *homo cogitan*s.

Homo virtuensis - the term '*axiological reason*' refers to the cognitively valuing abilities associated with values of any kind (evaluation). Axiology is a branch of philosophy that deals with the study of values, and axiological reason focuses on the skills of understanding, analyzing, and evaluating values, including moral, social, cultural, and other aspects related to the philosophy of values. It is therefore crucial for making conscious and responsible decisions related to values, both at the individual and societal levels. In this sense, axiological reason enables the realization of the axioeventistic postulate and thus embodies the concept of a human being as *homo virtuensis*.

Homo Contemplans - the term '*contemplative reason*' refers to cognitive abilities associated with contemplation, which involves focusing attention on the meaning, essence, and deeper aspects of life and reality while simultaneously affirming reality. In this sense, we are dealing with *positive contemplation*. On the other hand, focusing on destructive processes, regardless of what they might be, signifies *negative contemplation*. Generally, contemplation is a form of thinking that transcends the everyday and focuses on reflecting on the existence of anything and the nature of that existence, understanding one's place in the universe, or matters of a transcendent nature. Examples include religious contemplation (characterized by *reverence* for the sacred) or aesthetic contemplation (of a *sublimatory* nature) regarding various objects (artworks or nature). This capacity of the human mind justifies the designation of a human as *homo contemplans*.

Homo societus - the term '*social reason*' primarily concerns cognitive abilities of the human individual related to *cooperation* in various social communities. It involves the ability to interpret and understand social situations, norms, values, and interactions between people. Social reason is essential for effective functioning in society as it enables the comprehension and appropriate response to various social situations. The ability to understand the intentions, emotions, and needs of other people is crucial in interpersonal relationships. Additionally, the skill of reading social cues allows for better navigation in the social environment. The human, as an exemplar of the Homo sapiens species, is inseparably linked with social communities; thus, it is *homo societus*.

3. *The Dignity of the Human Person* - an anthropological assumption derived from the fact that humans possess a highly developed self-awareness and a broadly understood reason compared to other animal species. Dignity is a construct (attribute) ascribed to every human by humans themselves; it has no basis in any vaguely defined ontic structure of humanity.

The essence of this attribute lies primarily in *anthropological purposefulness* in the Kantian sense. A human can never be a means to an end, an object of manipulation, but an end in itself. And if it happens that they are a means, it is only on a voluntary basis, without any form of pressure, by choice. Secondly, every human, as a human, deserves *respect* – treating each individual as a person who possesses individual, diverse needs, expectations, personal beliefs, customs, and traditions that, because they are important to them, should also be important to others (provided, of course, they align with positive values).

Furthermore, dignity is something *inalienable*; dignity cannot be *renounced*. Last but not least, dignity is *absolute* – every human, without exception, possesses complete, non-gradual dignity. Human dignity is not contingent on any conditions, place, or time.

4. *Self-realization* - it can be positive or negative. *Positive* self-realization (in line with the realization of the *Axioeventistic Postulate*) means the maximal empowerment of human cognition (*cognitive reason*), the realization of positive values (*axiological reason*), contemplation (*contemplative reason*) of reality combined with its affirmation, and cooperation (*social reason*). Properties opposite to the ones mentioned above constitute *negative* self-realization.

Perfection (perfectionism) - the pursuit of achieving the highest standards of development and fulfilling one's potential. This form of self-realization encompasses various aspects of life, including intellectual, moral, and physical dimensions. It may also involve striving for professional success, setting ambitious career goals, and developing the necessary skills to achieve them.

Happiness (eudaimonism) - characterized by the pursuit of a subjective state of well-being and satisfaction with life. It is a multidimensional concept that includes both emotional and psychosocial aspects. Happiness is often associated with positive emotions such as joy, satisfaction, peace, or gratitude. The pursuit of experiencing these emotions can be an element of self-realization when the individual focuses on what brings them genuine joy. Happiness is often linked to the quality of social relationships. For many people, a significant aspect of self-realization is building close and satisfying relationships with others. These relationships may include friendships, family, love, and social engagement. Self-acceptance, both in terms of strengths and limitations, is a key element of self-realization. Individuals who accept themselves usually find it easier to achieve life satisfaction and experience profound happiness.

Pleasure (hedonism) - understood as a form of human self-realization, involves experiencing and seeking pleasant emotional states and favourable experiences. Although pleasure is generally associated with moments of relaxation and joy, it can also play a role in the process of self-realization. Experiencing pleasure can be crucial for managing stress and maintaining well-being. Moments of relaxation, entertainment, and pleasure can contribute to mental and physical balance, which is essential for the effective functioning of an individual. The pursuit of pleasure can also be part of a broader process of self-realization, involving finding a balance between different areas of life. Proper consideration of both professional responsibilities and personal needs can contribute to a fuller and more satisfying life. Thus, seeking to maximize pleasure and minimize suffering, an individual realizes themselves by caring for their well-being.

Philosophy of Social Collectives. The constitutive features of social collectives include the following: justice, freedom, and security.

1. *Justice*[134] – understood as the procedure for resolving conflicts between parties (individuals, institutions) by an impartial and competent judge in accordance with natural law in the aspect of the constitutive features of the human individual and social collectives. The judge's decision regarding a specific conflict depends mainly on three factors: firstly, the amount of information they possess, secondly, the fair assessment by them of the utility of the factors taken into account, and thirdly, their subjective assessment of the probability of events described by the above factors. In this regard, the following principles of justice can be outlined:

The principle of axiocreational situationalism – adapting the judge's decision to the strictly defined axiocreational situation generated by the conflict they are to resolve.

The principle of essential approximation – a decision-making procedure that maximally approaches the constitutive features of the human individual and social collectives.

The principle of maximal utilization of all available information.

The principle of impartiality of the judge - implies the absence of biases towards parties (individuals, institutions) and a thorough proliferative analysis (static or dynamic) using the technique of maximizing the average utility, thus taking into account all available factors characterizing the conflict situation, determining the utility of the outcomes, and the subjective probability of their occurrence.

The principle of equal treatment of individuals, social collectives, or institutions belonging to the same category. This principle decisively excludes any form of privilege. Granting privileges to

[134] See: Władysław W. Skarbek (2022), *Axioeventistic Conception of Law*, Warsaw Rideró, pp. 180-192.

certain individuals, social collectives, or institutions within the same category leads to the disintegration of the essence (set of constitutive features) of objects belonging to that category. This is synonymous with the realization of negative value, in this case – injustice.

2. *Freedom* – it can be negative or positive. Negative freedom either means freedom from internal constraints of the individual (immanent, subjective-formal), or freedom from external constraints in the aspect of the individual or collective (transcendent, objective-formal). On the other hand, positive freedom either means freedom for any self-realization of the individual (immanent, subjective-real), or freedom in the aspect of positive self-realization of the individual or essential realization of the collective (transcendent, objective-real): (Table 9.4.).

<table>
<tr><td rowspan="3">Negative freedom</td><td colspan="2">Immanent (subjective-formal)</td></tr>
<tr><td rowspan="2">Transcendent (objective-formal)</td><td>Human individuals</td></tr>
<tr><td>Social collectivities</td></tr>
<tr><td rowspan="3">Positive freedom</td><td colspan="2">Immanent (subjective-real)</td></tr>
<tr><td rowspan="2">Transcendent (objective-real)</td><td>Human individuals</td></tr>
<tr><td>Social collectivities</td></tr>
</table>

Table 9.4. Types of Freedom

Negative-Immanent Freedom (Subjective-Formal) – freedom from internal compulsion (including passions in the Stoic sense); an internal sense of absolute freedom (Stoic ataraxia). However, there is no freedom from such internal conditions, i.e., regularities inherent in the psycho-mental nature, equally for humans as a species and as individuals.

Negative-Transcendent Freedom (Objective-Formal) - freedom from external compulsion, especially from compulsion exerted by various socio-political collectives with an oppressive character. (a) Individual Freedom – freedom from external compulsion for a positively self-realizing individual. However, there is no freedom from compulsion for a negatively self-realizing individual. In this case, external compulsion is necessary. (b) Collective Freedom – freedom from external compulsion for collectives realizing their essence. However, there is no freedom from external compulsion for collectives manifesting properties beyond their essence; it is necessary to counteract the exacerbation of social evil.

Positive-Immanent Freedom (Subjective-Real) - individual freedom for the realization of both positive (towards positive values) and negative (towards negative values) aspects in the subjective sphere, i.e., the mental-psychic and emotional sphere (according to the legal maxim: cogitationis poenam nemo patitur). The individual has the freedom to choose whether to be a good or a bad person. But, of course, provided that their negative side is not exposed in real action.

P*ositive-Transcendent Freedom* (Objective-Real) – freedom for the positive self-realization of the individual and the essential self-realization of social collectives. At the same time, it should be emphasized again that each positive self-realization and the essential realization of collectives are subject to specific external conditions.

a) *Individual Freedom* – freedom solely for the positive self-realization of the individual. No freedom to exacerbate personal negative values.

b) *Collective Freedom* – freedom solely for the realization of the essential social collectives. No freedom to exacerbate social evil.

3. *Safety* – it can be personal or structural. Personal safety includes positive aspects – the existence of optimal hic et nunc conditions for positive self-realization of the individual and negative aspects – the absence of threats to the existence hic et nunc of the individual and its positive self-realization (psycho-emotional safety). *Structural safety* includes *positive* aspects – the existence of optimal hic et nunc conditions for the realization of the essence of any social collectives and *negative* aspects – the absence of threats to the hic et nunc existence of social collectives and their essential realization (socio-political safety).

Positive Personal Security - the existence of optimal conditions for the positive self-realization of the individual (psycho-emotional security). Security, in this sense, has a subjective character, limited to the individual subject and synonymous with the possibility of the self-realization of the human being.

Negative Personal Security - the absence of threats to the existence hic et nunc of the individual and their positive self-realization (psycho-emotional security). Threat is a situation caused by the actions of an individual, social collective, forces of nature, or technical devices creating potential possibilities for various kinds of harm. Security, in this sense, is a state of non-threat, peace, and certainty that is the concern of the individual. Therefore, a state of relative balance between stability and instability is preserved, as well as between what can be predicted and what is unpredictable in terms of the individual's planned intentions.

Positive Structural Security - the existence of optimal hic et nunc conditions for the realization of the essential functions of any social collectives (socio-political security). Each collective realizes its proper (essential) functions; for example, a family realizes functions such as procreation, socialization, and economics, while a state realizes functions such as legislation, administration, and politics. Positive structural security, therefore, means the undisturbed realization of everything that belongs to the essence of individual social collectives.

Negative Structural Security - the absence of threats to the existence hic et nunc of social collectives and their essential realization (socio-political security). It is evident that the basic condition for negative structural security is the absence of threats both *external* (from other collectives) and *internal* (degenerative tendencies within the collectives themselves) to the essential realization of social collectives. Negative structural security thus conditions positive structural security.

10. AXIOEVENTISTIC EPISTEMOLOGY AND ONTOLOGY

10.1. Axioeventistic Epistemology

In classical philosophy with Aristotelian roots, first philosophy typically regarded the theory of being (ontology) as fundamental. However, since the times of Descartes, especially with Kant, as the starting point for all philosophical inquiry, at least in the predominant philosophical trends, there is an emphasis on reflection on the nature of knowledge and the knowing subject, thus addressing epistemological issues. The theory of knowledge is often referred to as epistemology (from the Greek '*episteme*' - knowledge) or gnoseology (from the Greek '*gnosis*' - cognition). The term '*gnosis*' was first used in the 18th century by A.G. Baumgarten, who distinguished the theory of sensory knowledge - inferior gnoseology, from the theory of intellectual knowledge - superior gnoseology. The term '*epistemology*' was introduced by J.F. Ferrier in his work *Institutes of Metaphysics* (1854) to denote the second fundamental branch of philosophy alongside ontology. Currently, both terms are used interchangeably.

In this discussion, we will focus solely on two issues: the dispute over the sources of knowledge and the debate on the knowability of reality.

10.1.1. Dispute on the Sources of Knowledge

When we inquire about the sources of knowledge, we are referring to two aspects. Firstly, it could involve the *origin* of our knowledge, encompassing a well-organized collection of concepts, judgments, hypotheses, and theories. Secondly, it might pertain to the *methods* through which we can attain reliable, well-grounded knowledge. The problem of knowledge can thus be examined from both a *genetic* and *methodological* perspective. Table 10.1 presents the major positions in the dispute on the sources of knowledge in both of the aforementioned aspects.

Criterion	**Genetic Aspect**	**Methodological Aspec**
Empiricism	Extreme Genetic Empiricism (*Sensualism*)	Extreme Methodological Empiricism (*Aposteriorism*)

	Moderate Genetic Empiricism	Moderate Methodological Empiricism
Rationalism	Extreme Genetic Rationalism (*Nativism*)	Extreme Methodological Rationalism (*Apriorism*)
	Moderate Genetic Rationalism	Moderate Methodological Rationalism
Irrationalism		

Table 10.1. Epistemological Positions in the Dispute on the Sources of Knowledge

Genetic empiricism asserts that all knowledge originates from the senses; the beginning of all cognition is contact with reality through them. Since medieval times, the famous proposition has been known: *nihil est in intellectu quod non prius fuerit in sens*u (there is nothing in the intellect that was not previously in the senses). Therefore, every concept must demonstrate its origin derived from sensory experience. The human mind is likened to a blank slate (*tabula rasa*), which, with individual development, gradually and successively records information in accordance with the process of acquiring subsequent experiences. Extreme genetic empiricism is known as *sensualism*. Its representatives were primarily philosophers of the 17th and 18th centuries, including J. Locke, D. Hume, and E. de Condillac. Etienne Bonnot de Condillac (1715-1780) presented a comprehensive sensationalist theory of knowledge. According to him, humans are cognitively passive beings, and knowledge comes entirely from external sources. The mind is compared to a receptacle that accumulates impressions and reflects upon them; therefore, the mind plays no essential role in cognition.

Methodological empiricism acknowledges that experience plays a dominant role in human cognition; all valuable knowledge has an empirical character. In Francis Bacon's work *Novum Organum* he emphasizes the role of observation and experiment in understanding. According to him, purely rational knowledge inevitably leads us astray by creating useless abstractions. Extreme methodological empiricism is called *aposteriorism*. One of its most well-known proponents is George Berkeley (1684-1753). He argued that any claim purporting to be valid must have justification that can be directly or indirectly based on experience. A similar conviction, especially concerning the formal sciences, was held by John Stuart Mill (1806-1873). The reduction of logical and mathematical propositions to the regularities of human psychology (known as psychologism) faced strong opposition from thinkers such as Gottlob Frege, Max Scheller, Martin Heidegger, and Edmund Husserl. This critique significantly contributed to the emergence of phenomenology, a influential movement in contemporary philosophy.

Genetic rationalism asserts that all valuable knowledge has its source in reason, while the senses play no significant role in the process of cognition. Extreme genetic rationalism is called *nativism*. According to this view, true knowledge is not discovered through laborious intellectual inquiries or empirical research because it is inherent (Latin: natus - born) in every human being. It is sufficient to be aware of it, discover it in one's own reason, or - as Plato says - recall it (Greek: *anamnesis*), what the soul has already beheld in the ideal world.

Methodological rationalism asserts the primacy of rational knowledge over knowledge based on empirical experience. Extreme methodological rationalism is called *apriorism*. It strongly emphasizes the independence of cognition from any empirical knowledge. Immanuel Kant formulated the thesis of apriorism by stating the possibility of the existence of synthetic a priori judgments, judgments that expand our knowledge but have nothing to do with experience.

Irrationalism. The term *rationalism* is sometimes used in opposition to *empiricism* and sometimes in opposition to *irrationalism*. In the first case, rational knowledge is contrasted with sensory knowledge, and in the second case, it is contrasted with knowledge based on a non-rational principle or some irrational forces. The negation of rationalism does not necessarily imply anti-rationalism; it does not negate basic logical principles and operations but aims to change the very concept of knowledge. The saying of Augustine Aurelius is famous: *credo ut intelligam* (I believe in order to understand), in which the autonomy of the human intellect is questioned, with religious faith brought to the forefront as a condition for true knowledge. The contemporary thinker Henri Bergson (1859-1941) conducted a strong critique of rational (intellectual) knowledge, using the most rational means, demonstrating that the intellect often leads to the distortion of reality as it is far from sufficient for its adequate apprehension. Reality constitutes a continuous and creative stream of life, eluding superficial verbalizing schemata.

Axioeventism takes a position of moderate empiricism (both in its genetic and methodological versions) and moderate rationalism (both in its genetic and methodological versions). Depending on the nature of the research, knowledge is grounded in both empirical experience and rational experience. The methodology of research, specific to a given type of reality, addresses these issues in detail.

10.1.2. Dispute over the Knowability of Reality

All scientific research ultimately aims to uncover the essential features and relationships characteristic of the studied reality. Therefore, it is about as faithfully reflecting it as possible, not only for purely cognitive reasons but also to be able to intervene in this reality, making intended, conscious transformations based on the obtained research results. In connection with this, a question of great theoretical and practical importance arises - what is truth and how can one distinguish true research results from false ones.

The concept of *truth* for everyday use has become closely linked to the concept of *truthfulnes*s. However, it should be noted that subjective *conviction* about telling the truth does not always align with the objective state of affairs, as mistakes, or truths in good faith, can occur, while *fraud* involves falsehoods in bad faith. On the other hand, the concept of truth in the *epistemological-logical sense* refers to a statement asserting something about a certain state of affairs; thus, truthfulness applies only to statements. This view was introduced into philosophy by Aristotle and solidified by Kant. There is also the concept of truth in the *ontological sense*, which involves the perfect alignment of any objects with their own nature (e.g., 'true man,' 'genuine leather'). The concept of truth itself has been discussed in Chapter 7.1. Now we will focus on the issue of the knowability of reality.

The dispute over the knowability of truth has been initiated since ancient times and has given rise to several positions. Among the most important positions in modern times, alongside the ancient ones (*agnosticism*, *scepticism*, *dogmatism*), we must include *epistemological realism* and *epistemological constructivism*.

Agnosticism (from Greek '*agnostos*' - unknowable). This view asserts that the entire reality (extreme agnosticism) or only certain parts of reality (moderate agnosticism) are inaccessible to human knowledge. Thus, the pantheist Baruch Spinoza (1632-1677) claimed that, out of the infinite attributes (qualities) of God, only extension and thought enter into cognitive relations with the human mind.

David Hume (1711-1777) denied the possibility of cognitively reaching real causal connections in the world; according to him, all we observe is the constant succession of events. According to Immanuel Kant (1724-1804), the object of human knowledge can only be a part of reality, the so-called *phenomenal world,* while the sphere of things in themselves, the so-called *noumenal world*, radically escapes the cognitive field.

Scepticism (from Greek '*skeptomai*' - I consider, seek). It maintains that the dispute over the knowability of reality belongs to those disputes that are inherently irresolvable. We cannot in any way demonstrate that we truly know reality, nor can we rationally justify the opposing thesis. An agnostic is firmly convinced of the fundamental impossibility of true knowledge, while a sceptic sees no basis for expressing either a positive thesis - about the knowability of the world - or a negative one - about its unknowability; they simply refrain from asserting decisive views.

It is necessary to distinguish methodological scepticism from epistemological scepticism as a certain view regarding human cognitive possibilities. René Descartes is considered the founder and proponent of methodological scepticism. His goal was to establish philosophy on unquestionable principles that would not be inferior to formal sciences in terms of clarity and precision.

A variant of epistemological scepticism can be considered epistemological probabilism, according to which, while it is indeed impossible to conclusively resolve the dispute over the knowability of the world, we can nonetheless probabilistically support a choice by indicating prevailing reasons.

Epistemological realism is a philosophical position in epistemology that posits the existence of an objective reality, and our beliefs and theories can accurately reflect this reality. Epistemological realism focuses on the nature of knowledge and the question of whether our beliefs can correspond to objective facts of reality. Epistemological realism assumes that there is one shared reality, independent of our individual experiences or beliefs. This reality is objective and is possible to be truly known.

Epistemological constructivism is a philosophical position that emphasizes that knowledge is actively constructed by the knowing subject rather than passively received from an objectively existing reality. It encompasses various variations and approaches, but in general, epistemological constructivists argue that our beliefs and theories are shaped by our experiences, social and cultural contexts, as well as our own conceptual frameworks and categories.

Epistemological constructivists highlight the *subjective* nature of knowledge, asserting that our perception and interpretation of reality are always conditioned by our individual experiences, points of view, and social context. At the same time, they emphasize the active role of the mind in constructing all knowledge.

Additionally, epistemological constructivists often adhere to cognitive *relativism*, suggesting that different cultures or communities may have different perspectives and ways of interpreting reality, with no clear, objective standpoint. Generally, epistemological constructivists acknowledge the contextual nature of knowledge, meaning that, in their view, it depends on the context in which it is created. This context may include cultural, social, historical, and individual elements.

A x i o e v e n t i s m adheres to the position of *axioepistemological realism*:

> **Def. 10.1.** ***Axioepistemological realism*** **is a position in the dispute over the knowability of reality, stating that reality is objective, knowable, independent of the knowing subject, and that true knowledge of this reality is possible.**

Reality is *objective* (independent of the knowing subject) and *knowable* - our beliefs (theories or models) can be adequate in relation to reality. This means that if our beliefs (theories, models) are true, they reflect the objective reality. Axioepistemological realism further maintains that there are objective *Relatively Isolated Systems* (objects, phenomena, broadly understood facts), regardless of whether they are observed or not.

10.2. Axioeventistic Ontology

10.2.1. Basic Ontological Positions

The basic ontological positions, the question of the essence of the Universe (Ontic Universe), and the issue of the regularities of change will be discussed.

There are many different divisions of ontological positions and directions, depending on the adoption of one or another principle of division. It seems that for a general orientation in basic determinations, or rather in the direction of determinations, the division of ontological positions based on the criterion of *arche* will be fundamental for philosophy. However, this is with the reservation that arche will be understood more generally; not only as the primal origin and the principle that differentiates them but as a self-existent being, i.e., one that does not require anything external to itself for its existence, as it constitutes the reason for its own existence.

In the philosophy of various historical epochs, there is, and it is obvious, reflection on reality in the broad sense, which is the natural terrain of human activity; this is the *sphere of immanence*. At the same time, since the dawn of history, humans have shown a metaphysical intuition directed towards an order that somehow *transcends immanenc*e; this is the sphere of transcendence. Therefore, keeping in mind these two spheres, we can distinguish all ontological concepts in philosophy into two categories – transcendent: spiritualism, objective idealism, and immanent: extreme realism, moderate realism, and eventism (Table 10.2).

<table>
<tr><td rowspan="2">Transcendentism</td><td colspan="2">Spiritualism</td></tr>
<tr><td colspan="2">Objective Idealism</td></tr>
<tr><td rowspan="4">Immanentism</td><td colspan="2">Subjective Idealism</td></tr>
<tr><td rowspan="2">Realism</td><td>Materialism</td></tr>
<tr><td>Moderate Realism</td></tr>
<tr><td colspan="2">Eventism</td></tr>
</table>

Table 10.2. Philosophical Positions According to the Arche Criterion

1. *Spiritualism* - the arche is a spiritual force, a non-personal spirit, or a Personal Spirit; it is usually associated with religious beliefs, although this connection is not necessary; one can be a philosophical spiritualist and simultaneously be a non-religious person, i.e., not include the arche in the sacred sphere.

2. *Objective Idealism* - the arche can be understood as the *eidos* (Plato) or *Idea-Reason* (Hegel). For example, Plato's eidos exists in a special way, absolutely independently of any minds and of all individual things in which it may embody itself.

3. *Subjective Idealism* - the arche is equivalent to the self, psyche, individual consciousness. According to G. Berkeley, a consistent representative of this approach, the entire real world boils down to the sum of perceptions that we possess. His concise formula is well-known: *esse est percipi*, meaning ‘to exist is to be perceived’.

4. *Realism* - the arche signifies either material things (*materialism*) or things somehow connected to a non-material element of any kind (*moderate realism*).

5. *Eventism* - the arche consists of events of any kind. While realism considers things as self-existent entities and, in a way, genetically primary compared to all other categories of being, eventism also understands things as specific events extended in minimal stretches of time and connected to each other by some energetic-based relationships.

A particular kind of eventism is *axioeventism* (Def. 1.1.). According to axioeventism, things (Latin: '*res*' - thing) constitute a certain fragment of the world of facts. 'Things' refer to certain natural objects (including so-called physical phenomena), perceived by a conscious subject in certain minimal time intervals. The ontological position recognizing the existence of things in this sense is called *axioontological realism*. However, the category of facts is broader. Facts, beyond things (natural objects connected by energetic relationships), also encompass any other objects or phenomena existing in the Ontic Universe, perceived from the perspective of the knowing subject in minimal time intervals. These could be, for example, psychological, social, cultural, artistic, religious facts, etc. The ontological position recognizing the existence of facts in this sense is called *axioontological factualism*.

> **Def. 10.2. *Axioontological factualism* is an axioeventistic position (the proper part of axioeventism) designating any Relatively Isolated Systems (RIS), perceived by the knowing subject in minimal time intervals, as *facts*, and in turn, their proper part is composed of *things* (axioontological realism).**

At this point, we omit issues related to the *subjectivity* or *objectivity* of facts. There is no doubt that, due to the criterion of subjectivity/objectivity, for example, a psychological fact significantly differs from a natural fact.

10.2.2. The Question of the Regularity of Changes

A significant philosophical problem is the question of regularity, a specific order within the broadly understood reality. It involves whether any events are subject to constant, unchanging laws, or if there is a certain randomness in the occurrence of events. If one acknowledges that there are regularities in reality, then the next question arises as to whether this order has an immanent character, inherent in reality itself, or if it has been imposed by some transcendence, by certain supernatural forces. Depending on the nature of the answers to these questions, three fundamental positions are distinguished: *determinism*, *indeterminism* and *fatalism*.

1. *Determinism* - acknowledges the existence of immanent regularities in reality. Generally speaking, these regularities involve the global dependence of later states in the history of the world on its earlier states. The nature of the relationship (types of determination) and quantitative dependencies (physical, socio-psychological laws) take on various forms in specific segments of reality, addressed by individual specialized sciences. In particular, these sciences focus on revealing constant, unchanging connections between objects of a particular kind, their elements, and properties that together form the dynamic structure of the analyzed fragment of reality. There are many variations of determinism: causal, functional, probabilistic (probabilistic determinism - Def. 2.10.), and teleological, which have been discussed in more detail in Chap. 2.3.

2. *Indeterminism* – a view denying the existence of regularities; according to indeterminism, all events in reality fundamentally unfold in an arbitrary manner. Indeterminism introduces an element of chance, randomness, or unpredictability into the conception of reality, in contrast to strict causality. The extreme version of indeterminism is called *accidentalism*.

3. *Fatalism* - assumes the presence of regularities in reality imposed by some transcendence. In philosophical thought, it is primarily associated with the belief in the inevitability of a preordained human fate and the impossibility of making any changes to it. Human activity, therefore, has no influence on the course of events, regardless of what one does; it will happen as it must, as it has been established for centuries.

Axioeventistic Approach

Axioeventism considers the issue of the regularities in all changes within the Ontic Universe (OU) in the context of the proliferation of Relatively Isolated Systems (RIS). These regularities are understood in two ways[135]: as objective *law of nature* (*lex naturalis*) and as their

[135] It should be emphasized that this issue can be meaningfully considered only in relation to the Ontic Universe. This is because the second constitutive element of the Total Reality – Reality of Abstract-Essential Structures (RAES) includes objects that are atemporal, a spatial, self-existent in being, and potentially passive (Def. 3.1.).

subjective reflections in the knowing subject – the so-called *natural laws* (*ius naturale*).

L a w o f n a t u r e (*lex naturalis*) can be defined in two ways: firstly, in a *formal-ontic sense* as the tendency to preserve the essential structure of Relatively Isolated Systems or as the tendency toward its proliferation (integrative-positive or disintegrative-negative). Secondly, in a *formal-human sense* as the tendency of Relatively Isolated Systems to maximize positively or negatively formulated *Teleological Abstracts* (Table 7.9.). Law of Nature (*lex naturalis*), concerning the dynamics of Relatively Isolated Systems, is characterized by probabilistic determination (*probabilistic determinism* – Def. 2.10.).

On the other hand, *n a t u r a l l a w* (*ius naturale*) is understood as the reflection of the law of nature in the knowing subject. Moreover, natural law (*ius naturale*) in relation to human beings, as self-aware and rational beings, is supplemented by the *A x i o e v e n t i s t i c P o s t u l a t e* - which commands the realization of the positive version of natural law (lex naturalis). Of course, this postulate has only persuasive power; freedom of choice towards good or evil is allowed (traditional freedom of will).

Law of Nature (lex naturalis) in a formal-ontic sense. With the concept of proliferation in its two aspects: disintegrative and integrative (Def. 2.8. and Def. 2.9.), one can determine the Law of Nature (*lex naturalis*) in a *formal-ontic* and *formal-human* aspect as well as Natural Law (*ius naturale*).

> **Def. 10.3.** ***Law of Nature in a formal-ontic sense*** **means that Relatively Isolated Systems globally or universally tend either to preserve their Essential Structure or to proliferate integratively towards determinacy (order, certainty, predictability) or disintegratively towards indeterminacy (disorder, uncertainty, unpredictability).**

Law of Nature (lex naturalis) can be characterized by three theses:

First – Relatively Isolated Systems strive to preserve their Essential Structure for as long as possible (mechanisms of its perpetuation are omitted at this point).

Second – Relatively Isolated Systems undergo integrative proliferation, i.e., development towards determinacy (order, certainty or predictability), or:

Third – Relatively Isolated Systems undergo disintegrative proliferation, i.e., development towards indeterminacy (disorder, uncertainty or unpredictability).

Law of Nature (lex naturalis) in the formal-human sense concerns objective regularities occurring in the human world, which are associated with a particular characteristic of humans, namely *Teleological Abstracts*. The natural reality does not have purposes, does not make evaluations in the purely human sense, such as distinguishing between good and evil, truth and falsehood, or beauty and ugliness. The law of nature in the formal-human sense is understood as follows (Def. 10.4.).

> **Def. 10.4.** ***Law of Nature in the formal-human sense*** **signifies the global or universal tendency of conscious subjects toward positive Teleological Abstracts or the tendency toward negative Teleological Abstracts.**

Conscious subjects (including humans) constitute a particular type of Relatively Isolated Systems. Their specificity has been emphasized in the concept of Teleological Abstracts (Table 7.9.).

Natural Law (ius naturale). The concept of natural law can be categorized into three fundamental groups.

The *first* group consists of laws of immutable content (*classical, static, substantial*), typically of a normative character (law as a set of norms). The source of law in this perspective is the divine essence or human nature (recognized by reason).

The *second* group comprises laws of variable content, usually of an axiological nature (*law as a set of values to be realized*). The primary source of law in this category is the human reason.

The *third* group encompasses laws with developing content (*dynamic concepts*). In this context, the source of law is often considered to be the divine essence and the dignity aspect of humans, with historical-social changes and shifts in legal consciousness serving as the driving forces of transformation.

In ancient times, the Stoic approach was among the more well-known concepts of natural law. The Stoics spoke of the law of nature, describing the regularities of Nature (Deity, Reason) as necessary and purposive. They distinguished between the law of nature and natural law, the latter being the reflection of the law of nature in human nature, i.e., in the physical and rational nature of humans. Axioeventism draws inspiration from these distinctions. Natural law is understood as (Def. 10.5.).

> **Def. 10.5.** ***Natural law*** **(ius naturale) is the reflection, more or less adequat**e, **of the law of nature (lex**

naturalis) in a conscious subject (particularly in the human individual).

Moreover, concerning humans as rational subjects, the *Axioeventistic Postulate* (Def. 9.1.) is accepted as a rational assumption. On the one hand, it proclaims the duty to realize positive values in the formal-ontic sense (essential integrative proliferation) and to avoid negative values (essential disintegrative proliferation).

On the other hand, it advocates the duty to realize positive Teleological Abstracts, including:

1. Platonic Trinity: Goodness – Truth – Beauty.
2. Constitutive features of the human individual: Life – Reasonableness - Dignity of the Person - Self-realization (perfection, happiness, pleasure).
3. Constitutive features of society: Justice – Freedom – Security.

Simultaneously, the *Axioeventistic Postulate* directs avoiding negative Teleological Abstracts. Of course, the duty mentioned in the *Axioeventistic Postulate* has weak power; it is essentially persuasive, appealing to the rational side of human nature, which, as known, is not always the strongest aspect of individual beings. In other words, the *Axioeventistic Postulate* allows freedom of choice.

10.2.3. The Question of the Essence of the Universe

Philosophers since ancient times have endeavoured to explore answers to fundamental questions related to reality, to what exists, and to how anything exists. The question about a principle that would be the foundation of everything, the question about the arche, naturally does not exhaust the entirety of the issue. Equally important are questions concerning the essence of the Universe, including its beginning or its finitude and infinity.

In contemporary physics, considered by some researchers as the most advanced methodologically in science, there is room for philosophical reflection. The issue of the influence of philosophy on sciences, especially natural sciences, constitutes a broader perspective on the philosophical assumptions in scientific theories, discussed in Chapter 1. Philosophical assumptions are generally recognized by scientists as foundational points on which some degree of a scientific theory is based, and at which, in principle, the influence of philosophy on science ends.

While the engagement of philosophical reflection in the field of sciences, particularly natural sciences, is something more, it is an attempt to grasp the natural reality from a philosophical perspective, in the light of principles that cannot be reduced to natural principles (such as dialectical principles or, conversely, stabilizing principles). This is how *John C. Baez* expresses himself on the role of philosophical reflection in the sciences:

> Modern theoretical physics is difficult to understand for anyone outside the subject. Can philosophers really contribute to the project of reconciling general relativity and quantum field theory? Or is this a technical business best left to the experts? I would argue for the former. General relativity and quantum field theory are based on some profound insights about the nature of reality. These insights are crystallized in the form of mathematics, but there is a limit to how much progress we can make by just playing around with this mathematics. We need to go back to the insights behind general relativity and quantum field theory, learn to hold them together in our minds, and dare to imagine a world more strange, more beautiful, but ultimately more reasonable than our current theories of it. For this daunting task, philosophical reflection is bound to be of help[136].

In his statement, J. Baez seems to argue for the need to combine technical knowledge with a profound philosophical understanding. This approach assumes that philosophers can contribute to the project of reconciling general relativity and quantum field theory by focusing on fundamental perspectives on the nature of reality underlying these theories. Baez emphasizes that while mathematics is crucial for formulating physical theories, it has its limitations. According to him, to make progress, it is necessary to delve into the fundamental principles underlying physics, which philosophers have been discussing for centuries. He shifts the focus of the discussion beyond mere mathematical equations, suggesting the need to comprehend and integrate fundamental philosophical concepts.

Baez encourages bold envisioning of a world that is '*more strange, beautiful, but ultimately more understandable*' implying that the ability for philosophical thinking can lead to new and deeper insights into the nature of reality.

Another researcher who sought to bridge the natural sciences with philosophy was *Carl Friedrich von Weizsäcker* (1912-2007), a German theoretical physicist and philosopher of science. Von

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[136] John C. Baez, *Higher-Dimensional Algebra and Planck-Scale Physics* [in:] *Physics Meets Philosophy at the Planck Scale*, eds. Craig Callender and Nick Huggett, Cambridge U. Press, https://arxiv.org/pdf/gr-qc/9902017.pdf.

Weizsäcker's position can be described as an interdisciplinary approach that combined scientific inquiry with philosophical contemplation of the nature of reality. He emphasized unity across various scientific disciplines, connecting physics, biology, and cosmology. Von Weizsäcker believed in the possibility of finding unified principles that could explain the diversity of objects in the universe, both in the microcosm and macrocosm:

> For one can speak, secondly, of a unity of nature in the sense of a unitary character o f the species of objects. This character expresses itself in quantum theory in the existence of objects with particular Hamilton operators. Today we believe that all species of objects can in principle be explained as being composed of a small number of species of elementary particles. In the case of inorganic nature, we all believe this to be so; in the case of living organisms, it is the hypothesis on which we have based this book. (…)
> Thirdly, in the context of contemporary cosmology, it makes sense to talk of the unity of nature as the totality of objects. One speaks of the world as if it were a single object. Quantum theory does indeed permit the composition of arbitrary objects into a new object. It even requires this composition, in the sense that it regards the actual state space of a number of coexisting objects as precisely the state space of the total object they compose; the isolation of individual objects is, in the eyes of quantum theory, always a mere approximation[137].

Von Weizsäcker's statement pertains to the unity of nature in the context of quantum theory, biology, and contemporary cosmology. Von Weizsäcker underscores the existence of a unified character of the species of objects in quantum theory, manifested through the presence of objects with specific Hamiltonian operators. This relates to the mathematical formalism describing the evolution of quantum systems. Quantum theory allows the description of various objects using the same mathematical tools, indicating a kind of unity in the structure and approach to depicting microscopic reality.

In the context of cosmology, von Weizsäcker speaks of the unity of nature as the sum of objects, treating the world as one object. He observes that quantum theory permits the composition of diverse objects into new structures. This reference to the ability to compose objects in quantum theory may suggest that comprehending the

[137] Carl Friedrich von Weizsäcker (1981), *The Unity of Nature*, Farar Straus Giroux, pp. 379-381.

cosmos requires a holistic approach, treating the entirety as more than the sum of its parts.

The question of whether the world had a beginning is a topic that has long engaged philosophers, scientists, and theologians. There are various philosophical and theological approaches to this question that reflect different beliefs and perspectives. Here are some of these approaches:

Theistic Creationism - within the theology of various religions, including Judaism, Islam, and Christianity, there is a belief in theistic creationism, asserting that the world had a beginning in an act of creation by God. In this context, the universe exists because God brought it into being.

*Philosophical Cosmological Argument*s - the existence of the universe necessitates the existence of a first cause. For example, the argument by Thomas Aquinas, *ex ratione causa efficientis*: premise one - every effect must have a cause; premise two - in a series of causes, it is impossible to regress infinitely; conclusion - there must be a first external cause (God).

Theories of an Eternal Universe - there are also philosophical theories suggesting that the universe could have existed eternally, without a beginning. These theories are based on various concepts such as the infinity of time or the cyclic nature of the universe.

Rational-Naturalistic Perspective - the universe could have originated according to the principles of physical processes and did not require any external initiation (e.g., divine creation).

The Kalam Cosmological Argument is one of the more popular philosophical arguments employed by Christian apologetics and is developed by William Lane Craig:

> Al-Ghazali frames the argument very simply; here is a quotation from him, “Every being which begins has a cause for its beginning. Now the world is a being which begins. Therefore, it possesses a cause for its beginning.” [1] We can summarize al-Ghazali’s argument by means of three simple steps:
> 1. Whatever begins to exist has a cause.
> 2. The universe began to exist.
> 3. Therefore, the universe has a cause.
>
> This little argument is so marvelously simple that anybody can memorize it and share it with another person. It just consists of those three short steps.
>
> Notice that it is also a logically airtight argument. If the two premises are true, then the conclusion follows necessarily.

> Anybody who wants to deny the conclusion that the universe has a cause of its beginning has to deny one of the two premises. He has to say that either premise 1 or premise 2 is false, and so the whole question comes down to that – are these premises more plausibly true than false?[138]

The name '*Kalam Argumen*t (sometimes also called the 'Kalam Cosmological Argument') is derived from the Arabic word '*kalam*' meaning '*speech*' or 'discussion.' This argument has its roots in medieval Muslim philosophy and theology, particularly in the school of kalam, which engaged in philosophical considerations related to Islamic theology.

Structuring the argument into three simple steps lends it logical coherence. If we accept both premises, the conclusion about the existence of a cause for the beginning of the universe seems inevitable. The argument is based on the idea that every existence must have a cause for its beginning. It assumes that the universe began to exist, leading to the conclusion that it must have a cause. Of course, this is an assumption, and like any assumption, it essentially suffers from arbitrariness; the conclusion is only acceptable when the initial premises are accepted. This argument is grounded in the principle of causality. It maintains that the universe could not exist on its own, and its existence requires a First Cause or God. For proponents of the Kalam Cosmological Argument, it is an attempt to demonstrate that the existence of God is a logical necessity in the context of the existence of the universe.

The Anthropic Principle is a philosophical and cosmological concept that posits our presence in the observed Universe is conditioned by the fact that intelligent life can exist only under certain conditions that allow its emergence and evolution. In short, the Anthropic Principle states that the Universe must be compatible with our presence because we are here to observe it.

There are various variants of the Anthropic Principle, but generally, two main categories can be distinguished:

Strong Anthropic Principle - posits that our presence as observers influences the properties of the Universe and its fundamental parameters. In this context, the Universe is perceived as an environment in which intelligent life can exist, and our presence affects the parameters and conditions that must exist.

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[138] William Lane Craig, The Scientific Kalam Cosmological Arument, https://www.reasonablefaith.org/writings/popular-writings/science-theology/the-scientific-kalam-cosmological-argument, pp. 1-2.

*Weak Anthropic Principl*e - suggests that certain conditions of the Universe are as they are because only under such conditions could intelligent life arise. The Weak Anthropic Principle states that our presence is a result of natural selection - we exist only in those places and times that allow for our existence.

The Anthropic Principle is often invoked in discussions about the so-called fine-tuning problem in physics, which involves the observation that many fundamental parameters of the Universe seem to be configured in a way that allows for the existence of life. Examples of these parameters include the *cosmological constant*, *gravitational constant*, and *electromagnetic constan*t. Some argue that these parameters are so precisely tuned for life that it seems improbable without invoking the Anthropic Principle.

The Anthropic Principle is the subject of extensive debates in philosophy and cosmology. Some view it as a useful tool for understanding our position in the Universe, while others criticize it as too speculative and challenging to empirically confirm. In any case, the Anthropic Principle raises questions about the relationship between the Universe and the observer and why our Universe appears to be conducive to intelligent life.

Axioeventistic Approach

According to the adopted assumptions in axioeventism, the Total Universe encompasses the *Ontic Universe* (OU) and the *Reality of Abstract-Essential Structures* (RAES). Within the Ontic Universe, 'natural reality,' which constitutes the entire reality studied by the natural sciences, exists objectively (independently of any knowing subject; negating the anthropic principle) in infinite time (*objective time*), which is part of the total-time (*eternalism*). The structure of the Universe (natural reality) at both the classical and quantum levels undergoes continuous irreversible and reversible proliferative processes and simultaneously entropic (towards indeterminacy) and negentropic (towards determinacy) processes[139].

The measurement referred to in quantum mechanics ‘forcing elementary particles to determine their properties, is nothing more than a metaphor illustrating intentional (from the perspective of a conscious subject) energetic intervention in the studied particle and its surroundings, collectively forming a Relatively Isolated System. In essence, elementary particles or quantum states exist completely

[139] Of course, this applies to the entire *Ontic Universe*.

independently of any measurement and are in no way created by measurement (*ex nihilo nihil fit*).

Resume

Axioeventism is a philosophical position that involves three main assumptions. *Firstly*, it embraces the concept of *Total Reality* (TR), which encompasses the *Ontic Universum* (OU) and the *Reality of Abstract-Essential Structures* (RAES). *Secondly*, it accepts *situationist essentialism*, asserting the existence of a precisely defined set of properties and relationships specific to individual classes of Relatively Isolated Systems (RIS), determining their structure. *Thirdly*, every fragment of the Ontic Universum (OU) is a *Relatively Isolated System* (RIS) subject to *integrative* (positive) or *disintegrative* (negative) proliferation.

Each *Relatively Isolated System* possesses a certain *global structure*, composed of a constant *essential structure* defining the essence, and a variable *accidental structure* determining non-constitutive properties and relationships of the system. The process of mapping the global structure (both essential and accidental) occurs in three stages. The *first* stage involves extracting, in any given fragment (*Object*) of the Ontic Universum, an *S-object* according to a specified *identification principle* (Id_{prcp}). The *second* stage involves creating an *S-construct*, which is an interpretation of the S-object based on a designated *interpretative principle* (Int_{prcp}). Finally, in the *third* stage, the S-construct undergoes *testification* with the initial fragment of the Ontic Universum in accordance with methodological procedures.

Every *Relatively Isolated System* is subject to dynamics described within the framework of the so-called *proliferative analysis*. This analysis distinguishes *disintegrative proliferation*, characterized by a decrease in the number of elements, the number of connections between them, or a decrease in the intensity of connections among elements. Conversely, phenomena exhibiting opposite trends indicate *integrative proliferation*. The dynamics of Relatively Isolated Systems are determined by various types of *causal*, *functional*, *probabilistic* and *teleological* determinants.

According to the second assumption of axioeventism, it embraces *situationist essentialism*. This means that it acknowledges the existence of a set of necessary, constant, and immutable features that determine the essence of any Relatively Isolated Systems within specific *Ontic Essentialist Situations* (OES). This understanding of essentialism applies exclusively to the Ontic Universum, as the Reality of Abstract-Essential Structures contains absolute essences independent of any situations. In this context, various forms of *constructivism*, prophesying the end of the essence of everything and the end of truth for the simple reason that everything is dependent on the current '*discourse*' appear nonsensical.

Within the *Ontic Universe*, three main categories are distinguished: the structural-static plane, the structural-dynamic plane and the structural-result plane. Within the first category, natural, psychic, and social reality are identified. The work devotes considerable attention to *natural realit*y, including theories of relativity, quantum physics, and cosmology. This is because contemporary physics has radically altered fundamental philosophical concepts such as truth, matter (physical object), time and space.

Therefore, according to the *Copenhagen interpretation* of quantum mechanics, as a result of measurement, the wave function undergoes 'collapse,' revealing the subatomic particle; without measurement, the particle would not exist. Axioeventism considers the reality at the subatomic level as a set of all possible quantum objects. However, these objects lack experimental content (*Object* - e.g., an electron before measurement), but they serve as a substrate (*ex nihilo nihil fit*) for *S-object* (e.g., an electron after measurement), the effect of the performed measurement. Of course, both the electron before measurement (*Object*) and the electron after measurement (*S-Object*) exist in terms of *ontic truth* (Def. 7.2.). On the other hand, the description of the properties of the electron, according to a certain interpretative principle, creates an *S-construct* that fulfils the condition of *correspondent truth* (Def. 7.2.).

Total Reality (TR), in addition to the *Ontic Universe* (OU), also encompasses the *Reality of Abstract-Essential Structures* (RAES). It includes *Mathematics Objects*, *Scientific Idealizations*, and *Universals* (positive, negative), which contain, among other things, the so-called *Teleological Abstracts* (Table 7.9.). RAES is characterized by the following features: *atemporality*, *aspatiality*, *staticity*, *self-existence*, and *passive potentiality*.

According to the third assumption of Axioeventism, every fragment of the Ontic Universe is subject to bipolar interactions. Specifically, these interactions occur either towards *indeterminacy* (uncertainty, chaos, disintegrative essentials proliferation and the prediction of the future) or towards *determinacy* (certainty, order, integrative essential proliferation and the reconstruction of the past). At the level of the *structural-result plan*e, these interactions are respectively associated with: *information* (uncertainty-certainty), *even*ts (chaos-order), *values* (disintegrative proliferation-integrative proliferation) and *time* (the prediction of the future-the reconstruction of the past).

Information – a set of changes (form) in one Relative Isolated System (RIS_y) resulting from the influence of informational interaction by another Relative Isolated System (RIS_x).

Event – any Relative Isolated System (RIS_y) that is the outcome of stochastic interaction by another Relative Isolated System (RIS_x).

Value – any Relative Isolated System lying either on the line of *disintegrative proliferation* (negative) or on the line of *integrative proliferation* (positive).

Time – an infinite sequence of intervals between predecessors and successors of temporal interactions (*objective time*); the reconstruction of the past or anticipation of the future (*subjective time*); the existence of a single, cohesive time in which the dynamism of reality is an effect of the 'ontic memory' of any Relative Isolated Systems (*total-time*).

In axioeventism, *human beings*, considered as conscious entities, are approached from the perspectives of both the individual and society. Positive constitutive traits of the *individual* include: life, rationality, dignity, and self-realization (perfection, happiness, pleasure). On the other hand, positive constitutive traits of *society* encompass: justice, freedom, and security. Whether understood as an individual or a member of society, a human being has the freedom to act towards both positive and negative values. The only limitation is the so-called *axioeventistic postulate* (essentially an appeal to the rational nature of humans), which proclaims the duty to strive for the realization of positive values and the avoidance of negative values.

Axioeventism distinguishes between the *law of nature* (lex naturalis) and *natural laws* (ius naturale). The law of nature in the *formal-ontic sense* refers to the tendency of any Relative Isolated Systems to either maintain their essential structure or undergo integrative or disintegrative proliferation. On the other hand, the law of nature in the *formal-human sens*e signifies the conscious entities' inclination towards positive or negative *Teleological Abstracts* (Table 7.9.). Meanwhile, *natural law* (ius naturale) is nothing more than the reflection, more or less adequate, of the law of nature in a conscious subject.

GLOSSARY

Axiocreative interaction is an interaction of a material-energetic or epiphenomenal (i.e., psychic, social) nature between any Relatively Isolated Systems concerning each other, either towards increasing disintegrative essential proliferation (*axioentropy*) or towards increasing integrative essential proliferation (*axionegentropy*).

Axioeventism: 1. *Ontic Universe*: (OU: natural, psychic and, social reality) is characterized by four equivalent types of interactions: informational, eventistic, axiocreative and temporal, which generate, respectively: information, events, values and time. Each fragment of the Ontic Universe constitutes a *Relatively Isolated System* (RIS), subject to positive or negative proliferation. 2. *Reality of Abstract-Essential Structures* (RAES: mathematical objects, scientific idealisations and universals) is characterized by five properties: atemporality, aspatiality, staticity, self-existence and passive potentiality.

Axioepistemological realism is a position in the dispute over the knowability of reality, stating that reality is objective, knowable, independent of the knowing subject, and that true knowledge of this reality is possible.

Axioeventistic Postulate states that a human being (respectively, as an individual and as a member of a collective) should strive to the maximum degree for the realization of positive values (essential proliferation of integrative nature) and avoid to the maximum degree the realization of negative values (essential proliferation of disintegrative nature).

Axioontological factualism is an axioeventistic position (the proper part of axioeventism) designating any Relatively Isolated Systems (RIS), perceived by the knowing subject in minimal time intervals, as *facts*, and in turn, their proper part is composed of *things* (axioontological realism).

Beauty: 1. *Sublimative contemplation* of the conscious subject towards any fragment of the Ontic Universe. 2. *Teleological Abstract* - a component of the *Platonic Triad*.

Disintegrative proliferation - a decrease, alternatively: in the number of elements, the number of connections between elements, or the intensity (strength, magnitude) of connections within a given Relatively Isolated System.

E v e n t is any Relatively Isolated System RIS_y that is the result of eventistic interaction by the Relatively Isolated System RIS_x. If the RIS lies on the entropy increase or negentropy decrease axis, it is called a *regressive event*, and if it lies on the entropy decrease or negentropy increase axis, it is called a *progressive event*.

E v e n t i s t i c   i n t e r a c t i o n is the interaction between any Relatively Isolated Systems (RIS) through a material-energetic or epiphenomenal (i.e., mental or social) medium towards the generation of chaos (entropy) or towards the generation of order (negentropy) in the Ontic Universe (OU). In other words, it is the process of decay (chaos) or aggregation (order) of any RIS at any levels of the OU.

F a c t is an event captured by the Observer within a certain defined, minimal spacetime interval $<t_1P_1 – t_2P_2>$, where: *t* – time, *P* – space. Formally: $<Z (t_1P_1 – t_2P_2)>$. In the case where *P* represents natural reality, and the natural fact constitutes a relatively permanent and static material-energetic object, it is then called a *thing*.

G l o b a l   S t r u c t u r e of any Relatively Isolated System consists of two subordinate structures: *the Essential Structure* (essence, being, nature) – a set of features or relations constitutive for the given Relatively Isolated System, and *the Accidental Structure* – a set of features or consequential relations (derived from the constitutive ones) in the given Relatively Isolated System.

G o o d n e s s : 1. *A Relatively Isolated System* achieving the optimum of integrative proliferation in any fragment of the Ontic Universe. 2. *Teleological Abstract* – the goal of perfect harmony in the Reality of Abstract-Essential Structures - a fundamental element of the Platonic Triad.

I n f o e n t r o p y – the degree of uncertainty (unpredictability) regarding the magnitude of changes in RIS_y under the influence of the interaction of RIS_x.

I n f o n e g e n t r o p y - the degree of certainty (predictability) regarding the magnitude of changes in the RIS_y under the influence of the interaction with RIS_x.

I n f o r m a t i o n is the form of Relatively Isolated $System_y$ (RIS_y), meaning a set of changes within Relatively Isolated $System_y$ (RIS_y) under the influence of informational interaction from Relatively Isolated $System_x$ (RIS_x)

I n f o r m a t i o n a l   i n t e r a c t i o n is the interaction between any Relatively Isolated Systems (RIS) through a material-energetic or epiphenomenal carrier (i.e., mental, social, intelligible) with the aspect of increasing uncertainty (infoentropy) or reducing uncertainty (infonegentropy). In other words, it is the process of shaping the form of RIS_y by RIS_x.

Integrative proliferation - an increase, alternatively: in the number of elements, the number of connections between elements, or the intensity (strength, magnitude) of connections within a given Relatively Isolated System.

Law of Nature (*lex naturali*s) **in a formal-ontic sense** means that Relatively Isolated Systems globally or universally tend either to preserve their Essential Structure or to proliferate integratively towards determinacy (order, certainty, predictability) or disintegratively towards indeterminacy (disorder, uncertainty, unpredictability).

Law of Nature (*lex naturalis*) **in the formal-human sense** signifies the global or universal tendency of conscious subjects toward positive Teleological Abstracts or the tendency toward negative Teleological Abstracts.

Natural law (*ius naturale*) is the reflection, more or less adequate, of the law of nature (lex naturalis) in a conscious subject (particularly in the human individual).

Probabilistic determinism signifies either each interaction of given Relatively Isolated Systems among themselves with specified probabilities or their interaction only with a certain probability, the latter increasing proportionally with the greater number of Relatively Isolated Systems participating in the interaction.

Ontic Essentialist Situation (OES) is a Relative Isolated System with a specified set of *Boundary Conditions*, i.e., conditions that must be met for a given element to belong unequivocally (or at least with a high probability) to a particular class of Relative Isolated Systems.

Reality of Abstract-Essential Structures (RAES) comprises mathematical objects, scientific idealizations, and universals, and is characterized by the following properties: atemporality, aspatiality, staticity, self-existence, and passive potentiality.

Relatively Isolated System (RIS) - is a system that, during informational, eventistic, axiocreative, and temporal interactions with the environment, maintains its global (essential and peripheral) structure in a precisely defined ontic situation**.**

Religious value (faith) is a contemplation of reverential (imbued with respect) nature towards a certain conscious subject regarding any sacred entity, coupled with a supplicatory attitude aimed at assistance in worldly life, and the entire set of practices serving this purpose.

Situational essentialism is a philosophical position (adopted by axioeventism) that acknowledges the existence of a set of necessary, fixed, and immutable characteristics determining the essence of any Relative Isolated Systems, constituted by Ontic Essentialist Situations (OES).

System - is a distributive set (family of sets) comprising arbitrary elements $E_1 \dots E_n$, couplings between them $S_1 \dots S_n$ (internal relations), input-output relations $W_1 \dots W_n$ (external relations) between the elements of the system and elements of the environment. Formally: $S \Leftrightarrow (E_1 \dots E_n, S_1 \dots S_n, W_1 \dots W_n)$.

System-object (S-object) - a system distinguished within any object by virtue of a specified *identification principle* (Id_{prcp}) through defined eventistic interactions, i.e., interactions occurring between specific events in individual fragments of the Ontic Universe.

System-construct (S-construct) is a model of an S-object constructed by a given conscious subject based on a specified *interpretative principle* (Int_{prcp}). The model constitutes a set of more or less justified theses.

Temporal interaction is an ontic (informational, eventistic, axiocreational) interaction between any Relatively Isolated Systems in terms of the irreversibility of ontic interactions (predecessor-successor) or their reversibility (successor-predecessor).

Temporal interaction (***Quasi-temporal***) is an interaction involving the reconstruction of predecessors of the present or the anticipation of successors of the present by any conscious subject.

Time (***objective, cosmic***) is an infinite sequence of distances between predecessors and successors of ontic interactions (irreversible interactions) or between their successors and predecessors (reversible interactions). Predecessors are referred to as the past, and successors as the future. The present is the sum of the past and the future, i.e., the sum of predecessors and successors of ontic interactions. The sequence of interactions is recorded in the so-called ontic memory.

Time (***psychological***) is understood retrospectively as the reconstruction by a conscious subject of certain events (past) or prospectively - as the anticipation of certain events (future). The present is merely a minimal, unstable point between retrospection and anticipation performed by the conscious subject.

T i m e (***Total-time, eternalism***) - the concept of eternalism is a philosophical position according to which there exists a single coherent and simultaneous entity (the past, present, and future are indistinguishable), in which dynamism is treated as an illusion, resulting from 'ontic memory' (objective time), occurring within one static reality.

T r u t h : 1. *Ontic* – there exists an objective reality independent of any knowing subject. 2. *Correspondence* – the possibility of mapping within specific Ontic Essential Situations (OES) any fragments of the Ontic Universe (OU). 3. *Asymptotic* – the purpose of an infinite sequence of mappings of the Reality of Abstract-Essential Structures (RAES).

V a l u e is any Relatively Isolated System situated on the integrative line of essential proliferation (*positive value*) or on the disintegrative line of essential proliferation (*negative value*). The boundary point between integration and disintegration is formed by *indifferent value*s.

V a l u e (***Valid-Value***) is a such value, in one of its three meanings (Tab. 7.6.), distinguished by a conscious subject in the Ontic Universe due to the i*dentification principles* (Id_{prcp}) adopted by that subject.

V a l u e (***Considered-Value***) is a such value, in one of its three meanings (Tab. 7.6.), that is a model of Valid-Value constructed by a conscious subject due to the *interpretative principles* (Int_{prcp}) adopted by that subject.

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